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# The Dean Of DX

A History Of

Classic Radios

By **Marvin Hobbs** - Scott Chief Engineer 1939 • 1947

*Expanded Second Edition*

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**Scott Chief Engineer 1939-1947**

RADIO DAZE PRESS

# To The Radio Collectors Who Have Kept The Scott Legend Alive



First Edition Published 1985
By North Frontier Press
ISBN 0-933309-00-7
Library of Congress Catalog Card Number 85-061085

Second Edition Published 2002
By Radio Daze Press - John Slusser, Publisher
a Division of Radio Daze, LLC
Mendon, New York 14506
www.radiodaze.com
ISBN 0-9723301-0-0

*On The Cover:*

*Upper Left - Photo of E.H. Scott*

*Center - Perhaps THE rarest and most highly treasured classic radio - the 48 Tube E.H. Scott Quaranta (Courtesy Norman Braithwaite Collection)*

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THE STRADIVARIUS SCOTT OF RADIO RECEIVERS
NEWS OF LATEST DEVELOPMENTS IN THE SCOTT RESEARCH LABORATORIES
Vol. 2
APRIL, 1937
No. 10
PRESENTING
THE NEW SCOTT Philharmonic

# Preface

This book is the E. H. Scott story as I know it. My knowledge is based on two channels of information. Part of it I learned as the Chief Engineer of the E. H. Scott Radio Laboratories from 1939 to 1947. Also I worked as a radio engineer in Chicago for the Zenith Radio Corporation prior to joining Scott and was familiar to some extent with his activity before joining him. The other part of my knowledge has been derived from researching the published material as thoroughly as possible. This material extends back to 1921 when the first radio boom started in the USA.

Unfortunately when I worked for Mr. Scott, I never dreamed that I would be writing the first edition of this book in 1984 - some forty years later - or an expanded second edition some sixty years later! Therefore, I did not prepare for such an endeavor at that time. I would not have been able to write the first edition of this book without the assistance of Mr. J.W.F. Puett of Dallas, Texas, who preserved much of the Scott literature issued from 1925 to 1945 and whose information also pointed me toward other sources of Scott material. Also at that time, David Lachenbruch of Television Digest provided some of the detailed information on Scott post-war history and M. Harvey Gernsback, Editor-in-Chief of Radio-Electronics magazine, gave me access to his library of radio and wireless publications extending back to 1908.

To my surprise I found a vast amount of historical information about the progress of radio reception during the 1920's and 1930's in addition to the Scott literature. Although the expression "You have come a long way, baby" might be aptly applied to the evolution of radio technology, any notion that radio was in the stone age in 1924 has been completely dispelled. The activity from 1921 to 1924, which provided a stage from which Mr. Scott could launch his radio career, was a dynamic one in which the American public first accepted radio broadcasting and one which incubated the electronic age. Although I worked in the radio industry for more than fifty years, I now see those early pioneers of radio as I never saw them before.

Since I wrote the first edition in 1984, additional information relative to the history of the company, the development of the classic high fidelity receivers and the details of the production performance of the company during World War II, has become available. Also, I had an opportunity to do more research on both the U.S. and foreign patents granted to Scott's inventive engineers.

The E.H. Scott Historical Society was formed during the 1990's. Its Director, John Meredith, found sources for some of the company papers and related items which had not been made public and made them available to me. They include:

- *"History of the E.H. Scott Radio Laboratories and its Future Prospects"* By E.H. Scott (1939).
- *"Report to the Creditors of the E.H. Scott Radio Laboratories"* by E.H. Scott (1939).
- *"An Agreement with Certain Creditors of the E.H. Scott Radio Laboratories, Inc. and said Corporation"* by E.H. Scott (1939).
- *"Report to Stockholders of E.H. Scott Radio Laboratories, Inc."* by E.H. Scott (1940).
- Nomination of E.H. Scott Radio Laboratories for the Army-Navy E Award by Navy inspectors and approval of it by the Chief of the Bureau of Ships (1943).

I prepared a paper titled "The E.H. Scott Wartime Radio Family" which was delivered August 30, 1996 before the Antique Radio Club of Illinois. Prior to that I had found a copy of a publication of the Navy Department Bureau of Ships titled "Catalogue of Naval Radio Equipment". During the war it had been classified "Confidential". Since then it has been declassified. In the catalogue, specifications of the RBO, RBO-1, RCH and RCK are given along with all other radio receivers used by the Bureau of Ships during World War II.

I went to the U.S. Patent Office in Viriginia to do further research on patents held by Murray Clay at his request. There I found that although his patent application for the "Background Noise Suppressor", otherwise known as the "Dynamic Suppressor of Record Noise" had not been granted in the USA, it had been granted in England.

Thus, I have found material for three new chapters and two appendices. Also, it has been possible to expand some of the chapters in the first edition.

One new chapter deals with the problems that Mr. Scott encountered due to lower sales in 1938 and the solutions which he proposed. Another new chapter gives more details of the production of Navy and Maritime receivers during World War II.

A third new chapter covers some details about RCA's Berkshire program. Although it was not a Scott product, I believe that Mr. Scott's demonstration of the Philharmonic before an audience at the U.S. Patent Office Centennial in the 1930's had an influence upon RCA's decision to develop such a product. Also, I was intimately associated with the Berkshire program in 1947 and 1948, after I had left Scott Radio.

I have collected copies of all the patents granted to inventors at Scott Radio and selected the most important text and figures from each patent. This collection would make the largest chapter in the book, so I decided to add it as Appendix A. Since some readers may wish to refer to a circuit diagram of a classic or military receiver while reading, a collection of these has been added as Appendix B.

Most of the material in the first edition is included in this second edition. Thanks again to Mr. Puett, Jim Clark and Joe Halser for their first edition contributions. I also wish to thank members of the staff at the Franklin D. Roosevelt and Harry S. Truman Libraries and the United States Air Force Museum for their cooperation in supplying photos and other material on the first Presidential Aircraft. I credit Major Robert C. Mikesh and the American Aviation Historical Society for operational details of the Sacred Cow Aircraft history given in Chapter 13. Many thanks to Kent King, John Meredith, the past efforts of the E.H. Scott Historical Society, Alan Douglas and several other individuals as noted herein for their contributions to this second edition. Also, I wish to thank Jim Clark for tracking President Roosevelt's aircraft to the Air Force Museum at Dayton, Ohio. There, he and Kent King were able to photograph the AR-1 receiver and confirm that it is still installed in the plane after so many years.

I particularly want to thank John Slusser of Radio Daze, LLC for his interest and cooperation in publishing this second edition. Among his contributions, he has added a color section to better display some of the chassis and cabinetry of Scott radios.

# Chapter 1

# Introduction

Originally in telegraph parlance, DX meant "distance." Radio listeners expanded the letters to mean "distant reception" or "distant transmission." By the definition of the World Radio TV Handbook, DX=long distance. From the earliest days of radio the reception of signals from a distant transmitter was considered to be an achievement. The greater the distance and the more consistent the results the greater was the achievement. During the first radio boom in the early 1920's the quest for distant reception of AM broadcast band* stations rose sharply. Receivers were judged by the number of distant stations they could bring in during the evening and whether they could repeat their performance on following nights. Short wave reception was only in its infancy then and was practiced almost exclusively by licensed radio amateurs. The AM broadcast band offered the only voice and music programs on the air.

E.H. Scott based his entry into the radio business on the DX performance of a receiver which he built and took with him to New Zealand toward the end of 1924. It was a broadcast band receiver built from what he considered to be the best parts then available. While there during the first quarter of 1925, he established the following records:

- Nineteen U.S. broadcasting stations heard from a distance of 6000 miles or more. Six of these stations were at least 8000 miles away and seven of them were at least 7000 miles away.
- 117 programs heard from a distance of 6000 miles or more. 19 of these programs were from stations at least 8000 miles away and 19 of them were from stations at least 7000 miles away.
- Six U.S. stations heard during one evening.
- Loop aerial reception of a U.S. broadcast band station 8375 miles distant.

* *The AM broadcast band is also referred to as medium waves (MW).*

When he returned to the USA, Scott sold kits of parts for radio receivers capable of such DX performance and cited it in his advertising many times during the next several years with a challenge to anyone to duplicate it. It has never been recorded that anyone duplicated Scott's 1925 reception records under similar conditions. Even with all the advances in radio and electronics since 1924, it would not be easy to do so today. Although he participated in various phases of radio receiver development and built a variety of sets during the following two decades (1925–1945) and was referred to as a master craftsman, a perfectionist and a pioneer of high fidelity, I have chosen to call him the "Dean of DX". I think that title best describes his expertise and the main thrust of his career and interest in radio at least until the late 1930's.

Today most DXing is done on the short wave bands, because it is relatively easy on the appropriate band to receive stations at any distance around the world. There are many thousands of listeners engaged in this activity and there are still some who try for DX reception on the AM broadcast band, which of course is much more difficult. There are many DX clubs around the world, but few of them concentrate on broadcast band DX reception.

The name "Scott" has been associated with radio and audio products for over three quarters of a century, but few people today realize that there have been two completely independent "Scott" companies during this timeframe. For about twenty-five years (1924–1949) Scott products were identified with E.H. Scott of Chicago, Illinois. For about the last fifty years Scott products have been identified with H.H. Scott and the company he founded in Massachusetts. There was some overlap during the late 1940's and the 1950's but by that time E.H. Scott was no longer with the company which he had founded. Actually there was no connection between the two companies and no relationship between E.H. (Ernest Humphrey) Scott and H.H. (Hermon Hosmer) Scott. They never even met each other. E.H. Scott was

the founder and president of the E.H. Scott Radio Laboratories and H.H. Scott was the founder and president of H.H. Scott, Inc.

Few people remember that as recently as 1947 the Scott Radio Laboratories of Chicago was running full page ads (see pages 11 and 12) in Time and other major magazines at least once a month. The owners of the Chicago company had by that time dropped the letters "E.H." from the name, because E.H. Scott was no longer with the company. He had sold out in 1944.

To distinguish further between the Chicago company and the one in Massachusetts, it must be pointed out that the E.H. Scott Radio Laboratories was started in the 1920's by New Zealand–born Ernest Humphrey Scott, who came to this country after World War I. The company in Massachusetts was started in 1947 by an American engineer, Hermon Hosmer Scott, who had worked for the General Radio Company in the Boston area prior to that time. This book is about E.H. Scott and his Chicago company and will deal only briefly with H.H. Scott and some of the author's personal knowledge of his work.

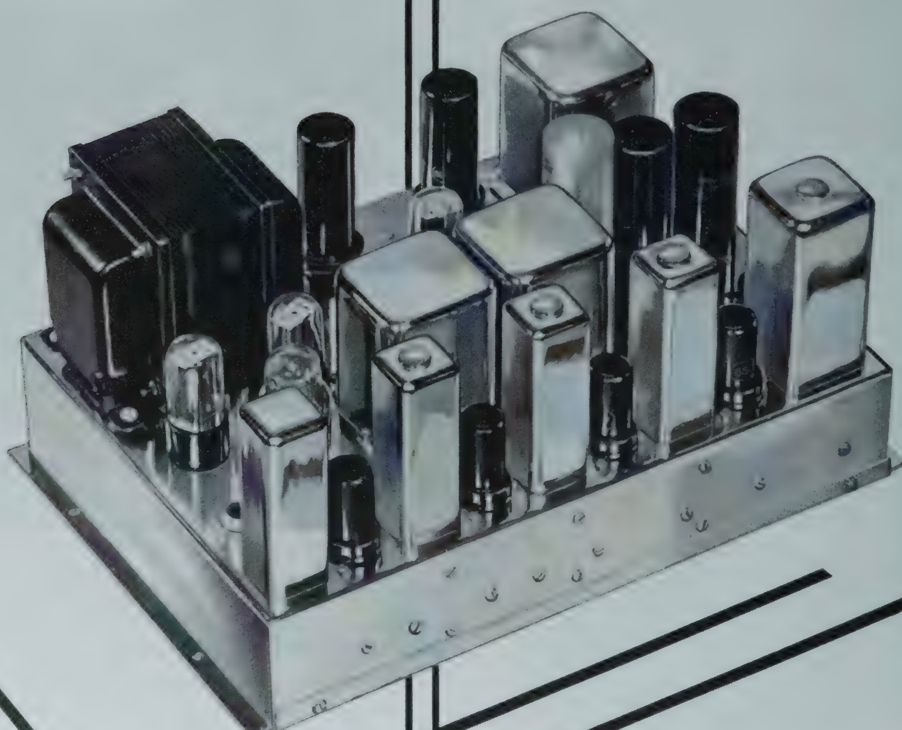
Although E.H. Scott was born in Dunedin, New Zealand in 1887, his father moved to Australia shortly thereafter and was killed in a railroad accident when Scott was only five. His mother also died when Scott was fourteen. To survive he became a messenger boy but advanced to a sales position within a short time. At the beginning of World War I he enlisted in the Australian–New Zealand Army Corps (ANZACs) and went to France. There he became interested in automotive troubleshooting and invented a simple device, called a telecator, to locate troubles in automobile engines. He sold the rights for his invention to the U.S. government and telecators were provided as standard equipment in army machine shops as well as being installed in tanks and tractors. The rights for this invention eventually brought him a total of $46,000.

During the war Scott found many American friends in Europe and when he was discharged, he decided to come to the United States, finally settling in Chicago. For awhile, Scott wrote a newspaper column entitled, "The Care of an Automobile". It was syndicated in a number of newspapers in the USA and Canada. During the first radio boom he became very interested in constructing radio receivers and was soon writing articles about his experience with them. To test various kits and circuits he maintained a small private laboratory. Based on his tests he began to supply many newspapers with radio articles on a weekly basis.

Being in a position to test and examine all of the radio set kits and circuits around, Scott decided to put together the best possible one in a portable carrying case, which he could take with him on a vacation trip to his native New Zealand. He built the set, which was later to become the World's Record Super 9, a superheterodyne with three i.f. stages. He set the long distance records (mentioned on page 9) while in New Zealand bringing in many USA AM broadcast band signals under adverse conditions during a thirteen week period in which he kept logs. Later that year when he returned to Chicago, Scott received hundreds of requests from radio fans asking for details on his World's Record receiver. He made them available, but many who constructed his receiver had difficulty obtaining optimum results and wrote to Scott for assistance. Because of this he decided to go into the business of supplying matched or aligned sets of i.f. transformers, which were thought to be the answer to most of the difficulties. In 1926 he started the Scott Transformer Company and began to sell kits with matched transformers for the World's Record Super 9 Receiver. From 1925 to 1927 Scott improved his kits and introduced a model called the World's Record Super 10, which was described by a leading radio publication of that day as "all that the most exacting and discriminating enthusiast can expect and desire from a radio receiver."

From this base the Scott legend grew. After this initial period he sold many kits to custom builders and eventually went into the assembly of complete receivers himself, moved to larger quarters and changed the name of the company to E.H. Scott Radio Laboratories. As from the beginning he strove for a deluxe product of high quality with period furniture styling in the cabinets which housed the sets and ample amplifiers and loudspeakers to provide adequate power and optimum fidelity. He included all of the tubes necessary to implement many special features which were built into the sets. By the mid–1930's Scott receivers were acclaimed for their performance and quality by the most critical users. They were in the hands of Arturo Toscanini, Rudy Vallee, Guy Lombardo, Lauritz Melchoir, Sir John Barbarolli and many other notables in and outside the world of music. The Hearst press used Scott receivers to monitor the news. Other owners included Baron de Rothschild, Colonel McCormick of the Chicago Tribune, Frank Lloyd Wright, Deems Taylor and countless connoisseurs of the very best.


SCOTT



From 1935 onward Scott began to emphasize high fidelity reproduction but without sacrificing short wave performance and built the best receivers that he could develop for AM broadcast band and short wave reception. He pioneered FM receiver development and built sets and tuners along with General Electric, Zenith and the other manufacturers who embraced it before World War II. The amplifiers in his prewar radios did the best that could be done with 78 RPM phonograph records by incorporating needle noise or "scratch" suppressors as they were called. Noise was a problem with radio reproduction as well as with phonograph record reproduction, so Scott developed antenna systems, balanced input transformers and noise suppressors to cope with that as well.

Entering World War II, morale receivers were developed and through the invention of a low radiation design, thousands of sets were built for the U.S. Navy, Maritime Commission, and Coast Guard. The Navy tuned banks of these receivers to various programs and piped them around the ships to amplifiers, where the sailors could select a number of programs by simply turning a switch. Through these installations as well as single receiver installations, practically every vessel in the fleet was equipped with one or more Scott morale receivers. The low radiation principle was applied to VHF receivers for installation on aircraft carriers and several of these were built. Toward the end of the war a special receiver was provided at the request of Donald Douglas for the first Presidential Aircraft–The Sacred Cow. This radio flew on many important missions in an aircraft which set several flight records and which served two Presidents–Roosevelt and Truman.

Toward the end of World War II, E.H. Scott sold his company and after awhile departed disagreeing with the new owners. The company continued on through the late 1940's and early 1950's, but Scott's leadership was missing. Scott radios no longer bore the stamp of the master craftsman and were never built again under the hand of E.H. Scott. All of the radios which were built under the guidance of Scott from 1924 to 1945 were sought by collectors. They became the tops in classic radio and have remained there to this day.

# Chapter 2
# The First Radio Boom

## Radio Receivers (1921-1924)

During the Winter of 1921-1922, within a period of three months, a surge of about 200,000 receivers were put into operation by listeners to bring the total up to about 700,000 sets in use nationwide. These sets were divided between home-made and factory-made units. This radio boom started on the East Coast and spread to the Midwest and westward by the Spring of 1922. In a price range of $25 to $250 and upward, one could have a store-bought receiver or one home-made from assembled discrete parts or from a kit of selected parts offered by a distributor or retailer.

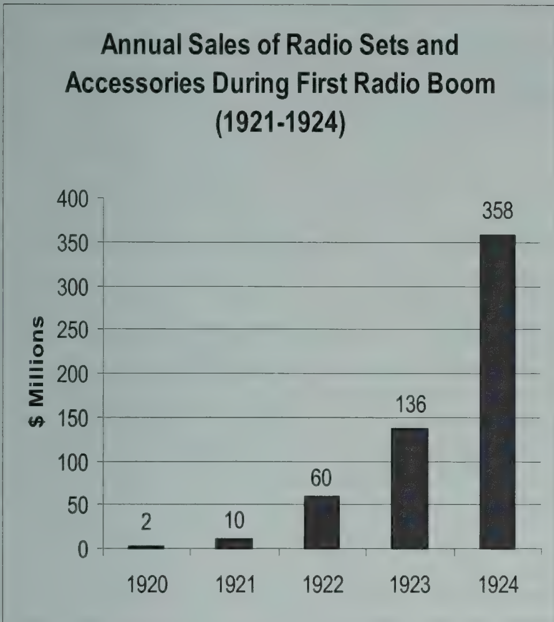
Initially radio program content was primarily musical. An example was that of the programs by the Chicago station KYW*, which began broadcasting in November 1921. At first opera was the sole feature offered by the station but later concerts were added. However, before the station observed its first anniversary, several new features such as markets, news, sports, addresses, children's bedtime stories, church services, and theatrical productions had been added to its program schedule. Politicians also became interested in radio broadcasting as a means for getting their messages across. By the end of February 1922, the top politician President Warren G. Harding had a receiver installed in the White House and had become an inveterate radio fan.

By May 1922, there were 4000 dealers, 3000 manufacturers of sets and parts and 1000 jobbers. Annual gross sales had risen to $50,000,000 of which $30,000,000 was for radio parts to be used by home set builders. These monetary figures may not seem dramatically high, but one must realize that the 1922 dollar had a much higher purchasing power than the 2002 dollar. 100,000 manufactured sets were being sold monthly, but the infant industry had a high degree of vulnerability with as many as 500 business failures reported each month. About 250 broadcast stations were operating nationwide but practically all shared time with other stations and operated on the same frequency of 833.3 kHz in the present broadcast band.

Within a year, by May 1923, annual sales had grown to $100,000,000 of which $70,000,000 was for radio parts. The number of dealers had grown to 6000 and the number of jobbers to 3000, but manufacturing companies had declined to 1000 due to business failures. Total industry failures numbered about 5000. The number of broadcasters had increased to more than 500 and the Department of Commerce had assigned many more frequencies spreading the stations to some extent across the AM broadcast band. However, broadcast power was still low, ranging from 500 to 1000 watts. Trade advertising had grown from $1,500,000 in 1922 to $10,000,000 and the news media began to take an interest. As early as March 1922, the Chicago Daily News was including a radio magazine section in its Saturday edition and by June 1922, the Sunday New York Times included a radio section in its Arts and Leisure section.

During the following period the media went technical and semi-technical for the only time in the history of radio and electronics. If they were doing something comparable today, they would be publishing technical articles and showing circuit diagrams to help you build your personal computer or your digital video disk recorder. A measure of the popularity of this approach in the first radio boom was evidenced by the number of newspapers publishing radio sections, which grew from ten in May 1922 to 600 by May 1923. It was into this expansion that Mr. Scott fit. Fascinated by radio receiver construction, he constructed many circuits from discrete parts and kits. With his technical writing experience in the automotive field, he was able to translate his experiences in building and testing a variety of circuits into articles helpful to many radio constructors. By the end of 1923, through his SNL Syndicate, Scott was

**Today KYW is a 50 kilowatt AM station operating on 1060 kHz in Philadelphia.*




selling articles to 112 newspapers in the USA and Canada.These articles were not highly technical, but more practical in nature. Circuit diagrams needed to be translated into wiring diagrams. Scott turned them into pictorial presentations, which made it easy for constructors to connect the parts without extensive technical knowledge. Many people read radio articles and wanted to try the circuits described in them, but could only do so if everything was spelled out for them in the most simplified manner. Scott supplied through his SNL Syndicate articles which filled these needs for many newspaper readers.

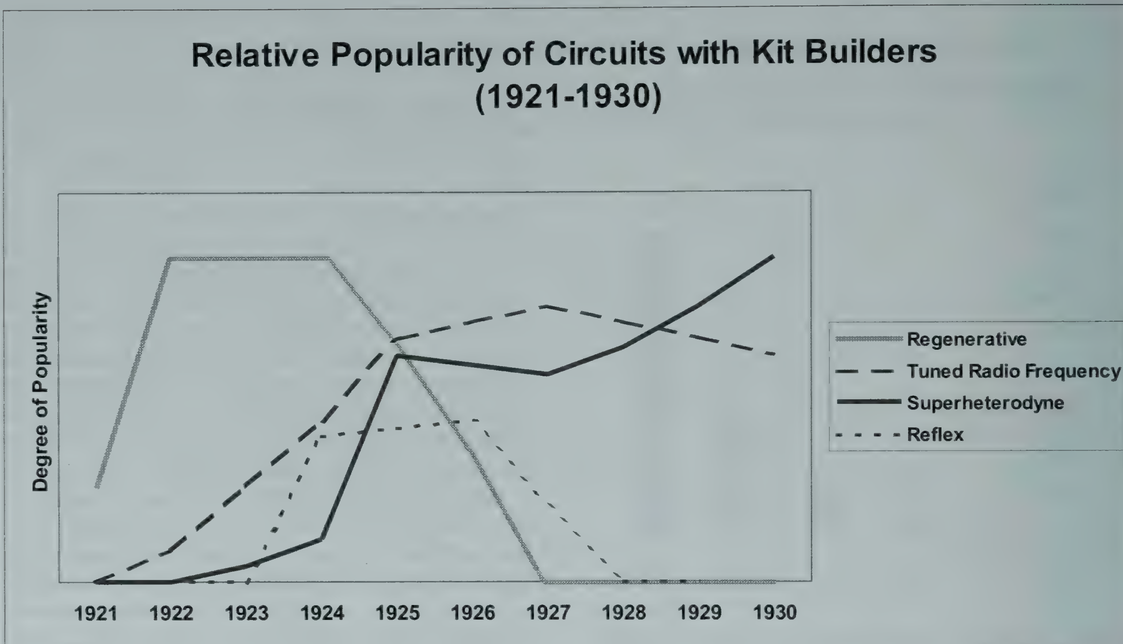
Despite the difficulties that many constructors had in getting optimum results from their handiwork, the receivers which fueled the radio boom of 1921 to 1924 were simple compared to the many types of receivers which were to be built later. A survey by the American Radio Association in mid-1924 estimated that there was between 3,500,000 and 4,000,000 sets in use. The crystal sets need little explanation, except to say that they used a crude semi-conductor compared to today's diodes. The tube sets ranged from one to five tubes. Most of them depended upon regeneration. All of them had to have a detector, which meant at least one tube in a tube-type set and that was as far as many tube sets went, if one was satisfied with headphone listening. Loudspeaker volume could be provided by adding one or two tubes as audio amplifiers. The more deluxe sets consisted of four or five tubes, with one or two used as r.f. amplifiers at the signal frequency ahead of the detector, which was followed by audio stages. However, the average tube receiver embraced not more than three tubes.

Several special circuits appeared by 1923. The principal ones of these were the super-regenerative circuit, the reflex circuit and the neutrodyne. Super-regeneration could provide a very sensitive single-tube set, but it was too critical in adjustment. It was said to require an engineer with it to obtain satisfactory results and it never became popular. The reflex circuit began to enjoy some popularity during 1923 and continued to appear in many receivers during the next few years. Its feature was the utilization of a tube to do the double duty of amplifying both at radio and audio frequencies simultaneously. Because of the considerable difference in these frequencies, such operation was possible within limits as long as signals at one frequency did not affect those at the other to the point where distortion occurred. The rising popularity of amplification at the radio frequencies led to the need to suppress oscillations at these frequencies. The neutrodyne circuit, which cancelled the positive feedback due to the capacity within amplifier tubes, provided this solution and gained popularity as tuned radio frequency amplification was incorporated in more circuit designs.

During the 1921-1924 period, Scott built and tested more than 200 variations of the above circuits plus a few others. He drew pictorial diagrams of the parts layout and circuit wiring. After they were built, he tested them to determine their reception capabilities. He presented the parts layouts and wiring diagrams as well as operating hints and performance data in the articles which his SNL Syndicate supplied to the newspapers in the USA and Canada. In this role Scott was not so much an innovator of circuits as a translator of them. He translated the receiver circuit information so that the set builders could make sets that worked. The need for this service was great, because so many novices were trying to build receivers.

## The Superhet Gains Ground

At the beginning of 1924 the radio boom of 1921




through 1923 in the USA had produced the following results:

- At least 3,000,000 radio receiving sets
- 10,000,000 listeners
- 541 licensed broadcast stations
- 250,000 persons directly or indirectly connected with the industry
- 3000 manufacturers of radio sets and parts
- 1000 wholesale dealers in radio sets
- 20,000 retailers of all kinds handling radio sets and parts
- 1000 newspapers carrying radio programs and radio news sections
- 2500 country weekly papers featuring radio news and information
- 50 periodicals devoted exclusively to radio and 50 magazines with radio sections
- 250 popular and technical radio books
- 7 trade papers devoted exclusively to radio.

Roger Babson was calling radio a utility instead of just an industry.

In all this advance of the radio industry, the superheterodyne had played a minor role. It was invented in France by Major Edwin H. Armstrong during World War I and a US patent pertaining to it was granted to him in June 1920. In October of that year he sold the manufacturing rights to the Westinghouse Company. At that time Westinghouse was independent of the so-called Big Radio Group, whose patents applicable to the manufacture of home radio receivers were controlled by RCA. However, in June 1921, Westinghouse joined this Group giving RCA control of the manufacturing rights of the patent. At that stage of development RCA was in no position to deliver to the public superhet receivers built on production lines and it was unwilling to license their manufacture outside of the Big Radio Group, which from the home radio receiver viewpoint consisted of RCA, General Electric and Westinghouse.

Despite these limitations on the manufacturing of superheterodyne receivers, the first superhet kit appeared in 1922 and an increasing number of such kits appeared during 1923. These kits involved only the selling of radio parts to individual builders whom RCA could hardly tackle as manufacturers (this aspect is explained more fully in Chapter 5). Although superhet kits were available from 1922 onwards, there were several reasons why they were not popular. Often the sets built from them did not yield good performance due to the quality of the components in the kits. Also, the superhet was more difficult to build than the simpler

regenerative and tuned radio frequency sets due to its complexity. The probability was greater that the kit builder would be more likely to make mistakes or take liberties in the construction which would lead to poor results. By early 1924, no manufacturer had yet offered a superhet to the public.

During the first half of 1924, the situation relative to manufactured superhets began to change. By March, RCA had finally placed superhet receivers in the hands of dealers. The receiver which they introduced was a sort of hybrid type, which Armstrong chose to call the Regenoflex second harmonic superhet. RCA got into the situation where this solution arose because they chose to limit the number of tubes to less than the eight or more used in the standard superhet circuits of that day. Actually, they were trying to reduce the set to five tubes, the number used in a typically good quality tuned radio frequency set consisting of two r.f. stages, a detector and two stages of audio.

To accomplish the desired result it was necessary to employ a single tube as the first detector and oscillator. With such an arrangement and a low intermediate frequency, the oscillator was so close in frequency to that of the incoming signal that considerable interaction existed in the tuned circuits of a tube which was performing both functions. An engineer who had served with Armstrong in France as a Sergeant, came up with a solution which even Armstrong did not originate. Harry Houck thought the answer was to have the local oscillator work at half the frequency of that in a standard superhet and to use its second harmonic to heterodyne the incoming signal down to the desired intermediate frequency.

Actually it was a patentable idea. Harry Houck filed a patent application for it on March 3,1923, but had to wait five years for the patent to be granted. By the time it was granted on October 2, 1928, RCA had discontinued its use. Although it was a rather brilliant solution to reduce the number of tubes in the superhet, RCA did not get away with five tubes. They had to add a sixth tube as an r.f. amplifier to act as what they called a "muffler" tube to provide some isolation between the oscillator and the antenna and thus reduce radiation.

RCA chose to drop the name Regenoflex and call the Radiolas, which they introduced in the Spring of 1924, just second harmonic superheterodynes. They were offered in a variety of cabinet styles with table models selling in the range of $269 to $289. Sales were excellent and the public's interest in the superhet took another step upward. Many prospective builders tried to obtain the circuit diagram and directions for building the second harmonic superhet. Dr. Goldsmith, RCA's laboratory chief at that time, who had been skeptical about the superhet as a production item initially but who later went along with the second harmonic idea, did as much as possible to discourage anyone from attempting to build the circuit at the home constructor level. He said, "I would not advise anyone to attempt to build a home-made superheterodyne operating on the second harmonic principle because I know the results would be extremely disappointing. If an experimenter took one of the sets apart and attempted to build a duplicate I am afraid he would experience great difficulty (He would even have had great difficulty taking it apart. All of the parts were mounted in a catacomb and sealed in wax-author's note.) A hookup or blueprint of the second harmonic superheterodyne would be about as useful in building the set as a map of Asia." Apparently, Dr. Goldsmith was successful in his attempts to discourage any home constructor from attempting to build the second harmonic superhet. There is no record of anyone offering such a kit or anyone concocting one on his own. RCA continued to enjoy its monopoly.

However, there were other large organizations engaged in superheterodyne receiver research. Two of these were US government agencies-the Signal Corps and the Navy Department. A third one was Western Electric. As the manufacturing arm of AT&T, it was not allowed to sell receivers to the public due to the patent agreements which AT&T had made with GE and RCA. However, it could develop and sell high-quality receivers to the broadcast stations and other non-public customers. One such model was their 4-B receiver, which was sensitive and selective enough to bring in distant stations in the presence of the transmitter with which it was associated. Kit designers began to look at this receiver and saw it as a much better candidate to adapt to their needs than RCA's second harmonic superhet.

The Western Electric 4-B receiver contained the same number of tubes as RCA's second harmonic type-a total of six. However, they were distributed differently across the circuit. The first detector or mixer and the oscillator were separate tubes. Two tubes functioned as i.f. amplifiers followed by a detector and one stage of audio. Also, it was completely shielded. The kit designers who followed the Western Electric design added a stage of audio to improve loudspeaker volume and in other cases another i.f. stage was added to bring the set up to eight

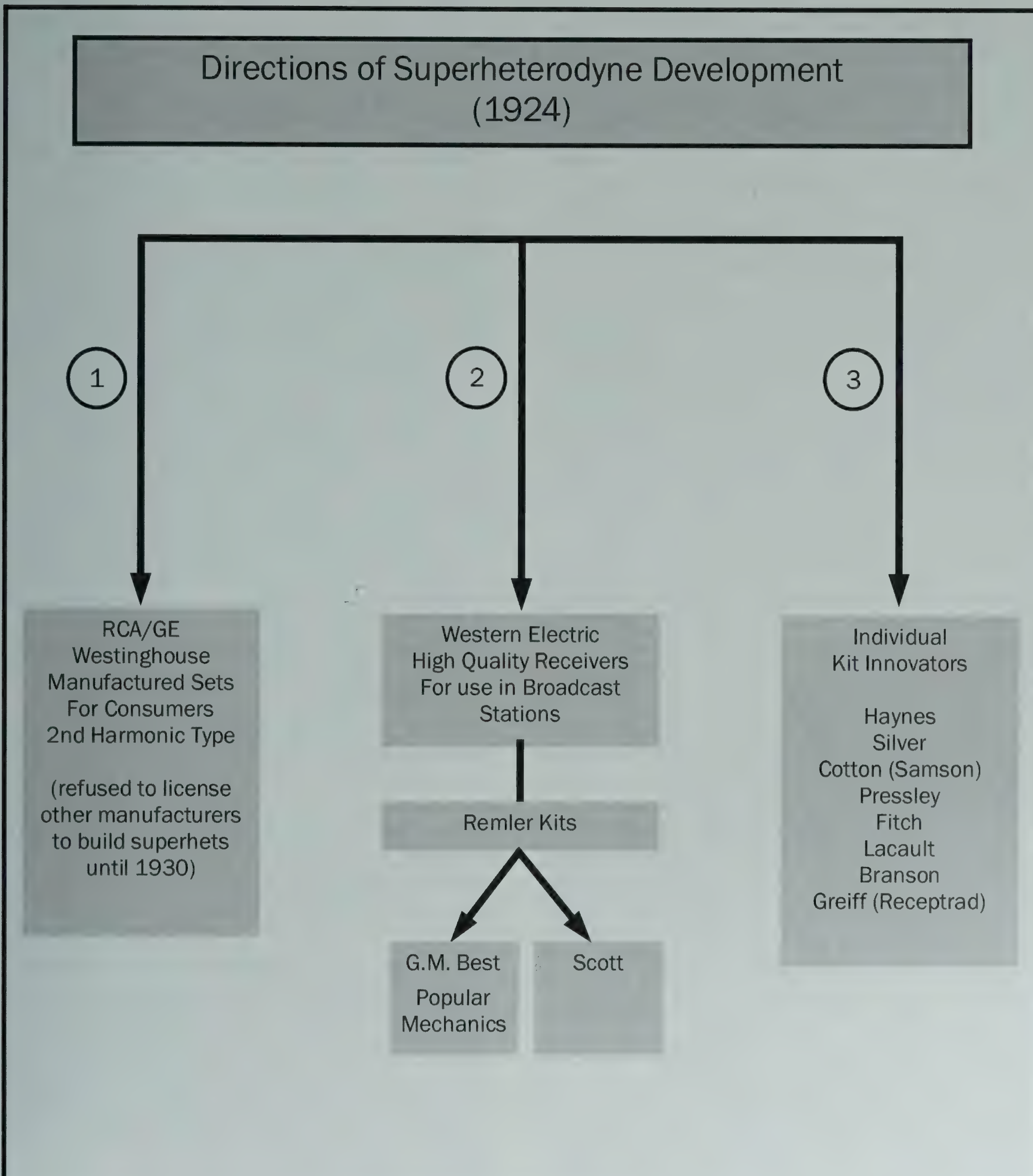
tubes. Part of the need to add stages was due to the fact that Western Electric had designed and built their own tubes, which were better than anything available on the open market. The added stages helped to make up or more than make up the difference.

Although the better superhet kit designs of 1924 generally purported to follow the design of the Western Electric 4B receiver, the engineer and the company that got the most credit for following it most closely was Gerald M. Best and the Remler Company respectively. Mr. Best redesigned the Western Electric circuit so that it could be built from radio parts which could be offered through the average retail supply store. Working for the Remler Company, Best designed the components for the r.f. and i.f. circuits as follows:

An r.f. coupler for the mixer and oscillator, type 620; Broadband i.f. transformers, type 600; An output i.f. transformer, type 610.

Three of the broadband i.f. transformers and one of the output i.f. transformers were used in the i.f. amplifier section which operated at 45 kHz**. Remler also supplied condensers, which could be used for tuning the loop and oscillator circuits. However, the transformers and coupler mentioned above formed the heart of the Remler superhet. Remler did not offer a complete kit of parts to build a receiver and left it up to the constructor to select whatever he cared to choose in other parts to round out a complete set. Some people criticized them for this approach, and argued that much better control of the circuit would have been realized if Remler had offered a complete superhet kit. As we shall see, it worked out better for Scott that he could choose the components which he thought would give the best results.

***-In 1924, the best technical minds in the business chose low intermediate frequencies in the range of 30 to 60 kHz, because with the components then available it was easier to obtain the necessary stage gain than at higher frequencies. One disadvantage of this choice was that it placed the image signal quite close to the desired signal in the broadcast band. During the years from 1924 to 1930, there was a gradual shift to higher intermediate frequencies. As coil, core and tube technology developed, it was easier to obtain the necessary gain at higher frequencies. In 1930, the designers of the RCA Radiola superhet said they chose 175 kHz as the intermediate frequency because it was the best compromise between amplification, stability, selectivity and undesired responses. As more short wave receivers were built, it was found that 175 kHz placed the image signal too close to the desired frequency to permit satisfactory image rejection. By 1933, intermediate frequencies of 262 kHz and 456 khz were being used. At that time, code interference was a problem at the latter frequency. Eventually, this problem was overcome by assigning different frequencies to transmitters which could interfere, and a frequency of 455 kHz was chosen as the i.f. for receivers which tuned the broadcast band. This choice moved the image signal frequency far enough away from that of the desired signal to make image signal rejection a practical reality.*


Directions of Superheterodyne Development
(1924)
1
2
3
RCA/GE
Westinghouse
Manufactured Sets
For Consumers
2nd Harmonic Type
(refused to license
other manufacturers
to build superhets
until 1930)
Western Electric
High Quality Receivers
For use in Broadcast
Stations
Remler Kits
G.M. Best
Popular
Mechanics
Scott
Individual
Kit Innovators
Haynes
Silver
Cotton (Samson)
Pressley
Fitch
Lacault
Branson
Greiff (Receptrad)

# Chapter 3

# Scott's New Zealand Vacation

## Preparing for the Vacation

After four years of hard work in the USA, Scott decided he needed a vacation. He could think of no place better to spend it than his native New Zealand. His parents had died quite a bit earlier, but his wife, who was also from New Zealand, had relatives at Tasman, a small town near Nelson on the Tasman Bay at the North end of the South Island. It was also not far from the Abel Tasman National Park. Although a small town, Tasman is a famous name in New Zealand. Abel Tasman was the first European discoverer of New Zealand in 1642. In addition to seeing Mrs. Scott's family, there were the picturesque mountain ranges to the West and South as well as the view at Tasman Bay. As Scott said, it was not a simple matter for him to take such a vacation. It meant traveling constantly for about a month and covering over 8000 miles by land and sea.

As he said once the vacation was decided upon, one of the first things he considered was the kind of radio receiver that he should take with him, for he was determined if possible to receive US broadcast stations while in New Zealand. Actually he had some information to encourage him that such reception would at least be possible. In March 1924, a broadcast station located in the Edgewater Beach Hotel in Chicago received a letter dated January 31, 1924 from Motueka, Nelson District, South Island, New Zealand, telling of its reception there. The type of receiver used was not indicated in the newspaper article covering this result. This reception was indicated to have broken all previous records for long distance reception of a Chicago station. Motueka is only a little more than five miles from Tasman.

Even with this thread of hope, Scott realized that he would need as sensitive and selective a receiver as he could build, if he was to receive consistently a number of US broadcast stations which were operating on only 500 to 1000 watts of output power at that time. He had had experience with the Neutrodyne, Tuned Radio Frequency circuits, Reflex circuits and all of the others including the Superheterodyne. Based on all of this experience he concluded that the Superheterodyne was the right choice for the finest receiver that he could build. He chose the basic Remler superhet components, which have been adopted from the Western Electric 4B receiver as described in Chapter 2. With that as a starting point, he introduced new design features both in circuitry and layout. The basic Remler design incorporated three untuned i.f. stages and one tuned i.f. stage. The use of some untuned i.f. stages and one tuned i.f. stage in superhets was common at that time. The untuned stages were to provide gain, while the tuned stage was to provide selectivity. At least that was the general concept. An untuned stage with a coil in the plate circuit of an amplifier would provide more gain than a resistance-coupled amplifier, if for no other reason because the plate voltage was higher due to the low d.c. drop in the coil.

A key circuit change introduced by Scott was to use two tuned i.f. stages and two untuned stages instead of the 1-3 combination. It was common in those days to use a fixed condenser across the tuned stage and to try to keep the i.f. tuning somewhere near the desired intermediate frequency by matching the coils. Scott placed variable condensers across the coils to be tuned and could make precise adjustments. However, when he did so he found that the i.f. amplifier broke into oscillation. So he simply adjusted the variable condensers across the two tuned i.f. stages just below the point of oscillation. In this way he realized a somewhat higher sensitivity and selectivity than was possible with the basic Remler circuit. In fact, Scott attributed the remarkable results which he realized in New Zealand to the fact that he used two adjustable tuned i.f. stages instead of one fixed-tuned stage in his specially built superhet.

When it came to the layout of components, Scott removed the bases of the tube sockets and mounted the top part of each socket on short fiber posts. In this way he realized the shortest possible leads and reduced

dielectric losses. He chose bypass condensers which had the least leakage. He liked the 360 degree dial provided by the Remler variable condensers, because he found that made tuning easier. Also, these condensers exhibited minimum effects from body capacity. He chose audio transformers which gave plenty of volume without distortion, and used rheostats free of scratchy noise with smooth and gradual control.

Scott completed his special superhet just in time to test its capability during the International Radio Week, which was held during the last week of November, 1924. During that period he picked up station 2LO in London, England, and a station located in Mexico. Although this reception was encouraging, it was nothing compared to the results he was to realize later in New Zealand. Scott left Chicago on his trip just at the end of November and travelled by train toward San Francisco.

He was so excited about the receiver that he attempted to operate it on the train as he sped along. He wrote to the Chicago Evening Post, which then owned the Edgewater Beach Hotel station WEBH, as follows:

"I have my superheterodyne with me on the train and last night had WGN, KYW, WQJ, WGY, KSD, and WOS, while we were speeding westward. I did not get things going until nearly 9 o'clock and tried my set out for about an hour with the loop inside the observation car, but all I could get was a few carrier waves and whistles. I thought that surely something was wrong and took off the front panel and looked all over for loose connections, but could find nothing wrong.

As a last resort, I took the loop and sat out on the rear platform of the train and in came WHO, Des Moines. I then carried the set and another passenger carried the loop, but as soon as we got inside the door of the car the signal faded out, proving that the steel car effectively shields the waves.

"Fortunately, I had a long piece of insulated cable with me, so I rigged up leads from the loop, which I left on the observation car platform and brought the cable ends into the car and connected them to the set. We had all of the stations listed above on a loudspeaker so that you could hear them in the farthest compartment of the car. We soon had a car full of interested passengers. We could not get anything ahead of the train. All we could get were those stations in the rear of it. I am going to try this out some more and will write the Post about it."

After reaching San Francisco, Scott wrote a letter to station WEBH, stating that he was well equipped and ready to listen to the special program which WEBH had agreed to broadcast for him after midnight on New Year's Eve. By that time he would have reached the home of relatives in New Zealand. On the day that he sailed from San Francisco, December 3, he wrote to WEBH as follows:

"I heard your station fine here last night. I also had KYW and WLS and about a half dozen eastern stations."

"I had my superheterodyne gone over here and experts who looked at and operated it declare it to be a "peach." (The Remler factory was in San Francisco and their experts were there-author's note.) I have had a stage of push-pull amplification built here in San Francisco and put in a special box. I am taking that along in case I need an extra "kick" to bring WEBH into my home in New Zealand." (This additional stage played a role later in escalating the eight-tube superhet into a nine-tube receiver, which Scott was to call the World's Record Super 9-author's note.)

"I am going to arrange with as many New Zealand fans as possible to tune in on WEBH when you send the special program to me. We will be waiting, and I think you will have a rather large crowd of south islanders listening for the station."

## Scott in New Zealand (1925)

Although Scott said nothing about it in his later sales literature, he had closer ties with the Edgewater Beach station, WEBH, than the other stations in the Chicago area. Perhaps this was due in part to the record which they set early in 1924 in getting through to Motueka, New Zealand, while they were still operated as the Zenith station, WJAZ. Although WEBH was first on his list for special programs arranged to be transmitted to him while in New Zealand, he also had arrangements for such programs from WGN on January 29 and WQJ on February 18. As mentioned in the previous chapter, WEBH was to do the first broadcast on New Year's Eve and the program was to be an all-night one. WEBH transmitted the program as planned but Scott did not receive it. Later in February, he did receive them and followed with considerable correspondence with WEBH personnel which shed considerable detail on various aspects of his activity while in New Zealand during the first months of 1925.

As covered in more detail to follow, Scott did not have a happy month of reception during January, 1925. The situation did not change dramatically until he received WGN's

broadcast on January 29. It was only after this reception that Scott wrote to WEBH telling them that he did not receive their New Year's Eve broadcast. In fact, he did not write to WEBH until he finally received them in New Zealand for the first time on February 8. On February 10, he wrote:

"As you know we had bad luck in getting the special test program that was sent out from WEBH; the night was awful and you could not get a thing through the code and static. However, on Sunday night, February 8, at 8:06 I was tuning around and all at once got the call letters. At 8:07 p.m. I heard a man singing and at 8:19 (probably meant 8:09 p.m.-author's note) heard the old familiar call, WEBH, but a burst of static came in and spoiled the announcement. I did catch the name Harry. At 8:10 p.m. there was a duet and at 8:11½ p.m. I got the whole announcement. It came in clear as a bell-Loos Brothers-the last number. It is now 2:33 a.m., or rather 2:43 a.m. in Chicago (the announcer made a mistake and corrected himself.)Then he announced the fact that they were raising a fund and contributions would be received by all Chicago stations, etc. Then WEBH, the Voice of the Great Lakes, Chicago, etc."

The reception of WGN's special program by Scott in New Zealand was reported in two relatively brief notes in the Chicago Tribune on two consecutive days as follows:

**January 29, 1925- WGN TRIES TO REACH N. ZEALAND**
**While THE TRIBUNE'S station, WGN, was conducting tests from midnight to 4 o'clock this morning in the hope of reaching New Zealand, Associated Press dispatches told how Australians had picked up music and speeches from America on Tuesday.**

**E.H. Scott of Tasman, Nelson, New Zealand, arranged two months ago to organize a group of amateurs to attempt to tune in WGN. Whether they will be successful in tuning in will not be known until today.**

**The music heard in Australia Tuesday is believed to have been from station KDKA, Pittsburgh.**

**January 30, 1925-NEW ZEALAND HEARS SPECIAL CONCERT OF WGN**
**Tasman, Nelson, New Zealand, Jan. 29-Last night WGN made history in radio reception. Although conditions here were at their worst, with extremely heavy static, which sounded like a buzz saw and with code interference making reception difficult, the extremely sharp wave of WGN cut through like a knife. The program was listened to for over two hours by E.H. Scott of Tasman, New Zealand. At 8:02 Quin Ryan's voice was recognized making an announcement. At 8:04 a baritone solo was heard. At 8:08 the following announcement was made: "This is WGN, THE CHICAGO TRIBUNE station, located on the Drake Hotel, Chicago, transmitting a special test program for listeners in Australia and New Zealand." At 8:16 Edna Solomon sang "Old Fashioned Rose." Other numbers were heard, but from 9:47 until 10:15 the static was too severe to be sure of the names of the selections.**

After receiving WGN's special program, Scott's spirits rose quite a bit so his letter of February 10 to WEBH continues as follows:

"I have been having a wonderful time with my set, a specially built superheterodyne. Since December 27, I have logged fourteen stations in the United States and one station in Australia. They are: KGO, at Oakland; KHJ, at Los Angeles; KFI, at Los Angeles; KNX, at Hollywood; KJR, at Seattle; CFCN, at Calgary; 9XG (WOC), at Davenport, experimental call; KFRU, at Oklahoma; WCBD, at Zion City; WGN, Chicago; WQJ, Chicago; WEBH, Chicago; KXAA, at Cincinnati; WFAA, at Dallas and 2BL, Sydney."

Actually the "wonderful time" had been bolstered somewhat from January 29 to February 10. WGN, WQJ and WEBH, all of Chicago, and KXAA (WSAI) Cincinnati, WFAA Dallas, and CFCN Calgary had all been received for the first time during that period. From December 27 to January 28 Scott had received only eight stations located in the USA - five of whom were on the West Coast, one in Iowa, one in Oklahoma, and one in Zion, Illinois. He had little trouble receiving KGO in Oakland, California. He had brought them in on nineteen nights during that period. All of the other stations had been received only on one night, except for KNX, Hollywood, which had been received on two nights.

Some of Scott's disappointment during the first month of listening in New Zealand was reflected in the continuation of his letter of February 10 to Station WEBH as follows:

"Static is the great bugbear here and code interference. The local cable stations operate on waves from 450 to 660 (meters) and from about 7 p.m. onwards you get it. They are going to raise the wavelengths very soon, I believe, and that will help matters considerably. But static, say, you have never heard it until you have listened to the variety they get here. It is the most malignant type and comes in roars

and crashes that nearly burst your ear drums. Sometimes it sounds just like being in a boiler factory when the code and static are severe."

"Yet, through it all you can receive, although the announcer has to be good or you don't get the call letters. I think that we have three of the stars in Chicago, for they get through it better than any of the announcers of the stations I have logged so far. I just wish I could have some announcers listen in with me here for about one hour some night and they would be much wiser and better announcers. The most of them think that the listener-in knows the call letters as well as they do and simply gable it off. I know that a larger number of stations would be heard if the announcer would only take the time to give the call letters slowly and with a distinct break between each letter, W-E-B-H. As a matter of fact, WEBH comes through fine, but just listen to some of them and note the way they rattle off the call letters. It would make a good subject for an article in the radio magazines. I could nearly write a book on how to get out a program that would be heard at distant points, for I have had enough experience in hearing them these last few weeks. I have nearly torn my hair out and gnashed my teeth. I have logged station selections for half an hour sometimes in the hope that I would be able to get the call letters, but in the finish I had to give them up. If you look at my log Feb. 7, you will find that I had a Detroit station and another station with a lady announcer, but it was absolutely impossible to hear the call letters. If I owned a broadcasting station I certainly would not have a lady announcer, for they do not get out."

"It is a pity that I did not make arrangements with one of the Chicago stations to conduct a few experiments with different classes of selections, etc., different styles of announcing, for I believe we could have got some valuable dope from such a test. It is too late now, however, for I will be leaving here about the end of March. If you want to put over anything like that you or they could cable me and I could arrange it."

During February, Scott picked up the special program arranged for him by station WQJ, Chicago. That program, transmitted on February 19, was logged for over two hours and a cablegram was sent to the Rainbo Gardens (WQJ was owned jointly by the Calumet Baking Powder Company and the Rainbo Gardens) quoting the highlights of the program. Later Scott received a letter from the Director of WQJ verifying Scott's log for the February 19th program and for another one broadcast in March. Having logged nineteen different US stations and having received sixty different programs by March 13, Scott wrote another letter to the Director of station WEBH as follows:

"I have managed to tune you in twice this month so far. Here is the log, March 5,6:30 p.m., piano; 6:36 p.m., announcer talking thru heavy static; 6:39 p.m., coming in fine, guitar, I think; 6:40 p.m., WEBH, Langdon Brothers; 6:40 p.m., another solo; 6:42 p.m., fading; 6:45 p.m. announcer talking through static."

"On March 8; 7:33 p.m., WEBH, etc.; 7:33 p.m., orchestra coming in fine; 7:36 p.m., WEBH, etc.; 7:38 p.m., man singing; 7:41 p.m., orchestra; 7:45 p.m., piano solo, good; 7:47 p.m., piano coming in well thru strong static; 7:56 p.m., WEBH: Selections just played on two grand pianos by Dean Remick and ....Brothers will sing and play; 7:57 p.m., duet by men; 7:59 p.m. WEBH.... Alamamba; gave names of performers, caught Langdon Brothers; said something about send in for something."

"Static has been terrific lately, but in spite of it I managed to pull in nineteen different United States stations and over sixty different programs. The super-power stations come in with an awful thud."

On March 27, Scott wrote another letter to WEBH, Chicago, as follows: "I made a rather good record about a week ago, when I brought in WCBD at Zion on the loop. As usual I started off with KGO at 6:22 p.m. That is a wonderful station. At 6:34 p.m. I tuned in KNX at Hollywood, and they were coming thru so well that I stayed with them until 7:30 p.m., when they signed off. The static was beginning to get bad by this time, but I thought that I would see if there was anybody else awake in the United States, so I did a little dial twisting, and at 7:33 p.m. just three minutes after I had heard KNX say good morning, I tuned in a lady singing and coming thru fine. At 7:38 p.m., in came the call WCBD. But the log will tell the story:

7:33 p.m., lady singing, and coming thru with great volume; 7:38 p.m., WCBD, announcer spoke for about two minutes; 7:40 p.m. strong code; 7:41 p.m., piano solo with, I think, another instrument; 7:44 p.m., WCBD, Zion, Ill., Hire; telegram from Chicago; 7:45 p.m., next Florence, Cal.; 7:47 p.m., instrumental selection coming in fine; now here is the interesting part; 7:50 p.m., switched to loop 61¾-84. Came in on loudspeaker O.K. with five of family listening; 7:52 p.m., WCBD, then strong spark cut in; 7:54 p.m., man singing a hymn; 7:55 p.m., very strong code and static; 7:57 p.m., man singing thru code; 7:58 p.m. announcer talking thru code and

static; J. Hire; 7:59 p.m., piano solo sounds like 'Men of Harlech'; 8:01 p.m., code strong, but piano coming thru; 8:05 p.m., piano coming thru with good volume; 8:06 p.m., announcer talking, but static makes words indistinguishable."

"I cabled WCBD that I had got them on a loop, so I would not be surprised if you already know about it. It is about 8,300 miles from Tasman to Zion and I am quite sure that it will be a world's record also for loop reception. I base this opinion on the fact that since I have been here I have been picking up stations that no one else in N.Z. is getting with any kind of receiver. Of course, a number pick up KGO now and again, but very few indeed ever get as far as Chicago. You will be interested to note that I have picked up WEBH on five different nights. So far they have been picked up oftener than any other station in the middle west."

"During the last six weeks static has been very bad. This is the time of the year when conditions are at their worst. The worst of it is that conditions will not alter very much until about June, and by that time I will be back in Chicago."

"I am still using the eight-tube super and would not trade for anything that I have seen so far. It is a wonder. I am bringing it back with me to use on the boat, and expect to do some work with it between Wellington and Frisco."

With this letter, Scott included a copy of his log book. It showed stations logged by him at Tasman, New Zealand, from December 27, 1924 to March 27, 1925, as follows:

**(1) WOC-Davenport, Iowa (7,900 miles), Dec. 27.**
**(2) KHJ-Los Angeles (6,000 miles), Dec. 28, Jan. 25, Feb. 15, March 15 and 25.**
**(3) KGO-Oakland (6,100 miles), Dec. 30,31; Jan 1, 2, 4, 6, 7, 9, 11, 13, 14, 16, 18, 21, 23, 25, 27, 28; Feb. 8, 15, 17, 18, 20, 22, 24, 25; March 3, 4, 5, 6, 8, 10, 11, 13, 15, 17, 20, 22, 24, 25, 27.**
**(4) KFRU-Bristow, Okla. (7,500 miles), Jan. 17.**
**(5) WCBD- Zion City, ILL. (8,375 miles), Jan. 18, March 17.**
**(6) KJR-Seattle, Wash. (6,800 miles), Jan. 27.**
**(7) KNX-Hollywood, Cal. (6,000 miles), Jan. 27, 28; Feb. 3; March 5, 10, 11, 12, 13, 17, 19, 25, 26, 27.**
**(8) WGN-Chicago (8,300 miles), Jan. 29; March 9.**
**(9) WQJ-Chicago (8,300 miles), Feb. 4, 19; March 12.**
**(10) CFCN-Calgary, Canada (7,500 miles), Feb. 4, 25; March 7, 8, 11, 14.**
**(11) KXAA-Cincinnati (8,400 miles), Feb. 5,8; March 14.**
**(12) WEBH-Chicago (8,300 miles), Feb. 8,15; March 5, 8, 26.**
**(13) KFI-Los Angeles (6,000 miles), Feb. 9; March 13.**
**(14) WFAA-Dallas, Texas (7,600 miles) Feb. 10**
**(15) WJJD-Peoria, ILL. (8,300 miles), Feb. 18.**
**(16) WDAF-Kansas City (7,600 miles), Feb. 19; March 5, 20.**
**(17) KLA-Cincinnati (8,400 miles), March 5.**
**(18) KPO-San Francisco (6,100 miles), March 5, 8, 25, 26.**
**(19) KOA-Denver (7,000 miles), March 8,12,15, 19, 26.**

"During the three months KGO was tuned in on forty-one different nights; KNX, 13 times; CFCN, 6 times; KHJ, 5 times; WEBH, 5 times; KOA, 5 times; KPO, 4 times; WQJ, 3 times; KXAA, 3 times; WDAF, 3 times; WCBD, 2 times; WGN, 2 times; KFI, 2 times; WOC, KFRU, KJR, WFAA, WJJD, KLA were each tuned in once.

"Practically all of the above stations were received between 6 p.m. and 7:30 p.m. in the evening. When it is 1 a.m. in the morning in Chicago, it is just 6:30 p.m. of the same day in New Zealand. We are seventeen and one-half hours ahead of Chicago time. This gives only about an hour and a half each evening to bring in American stations."

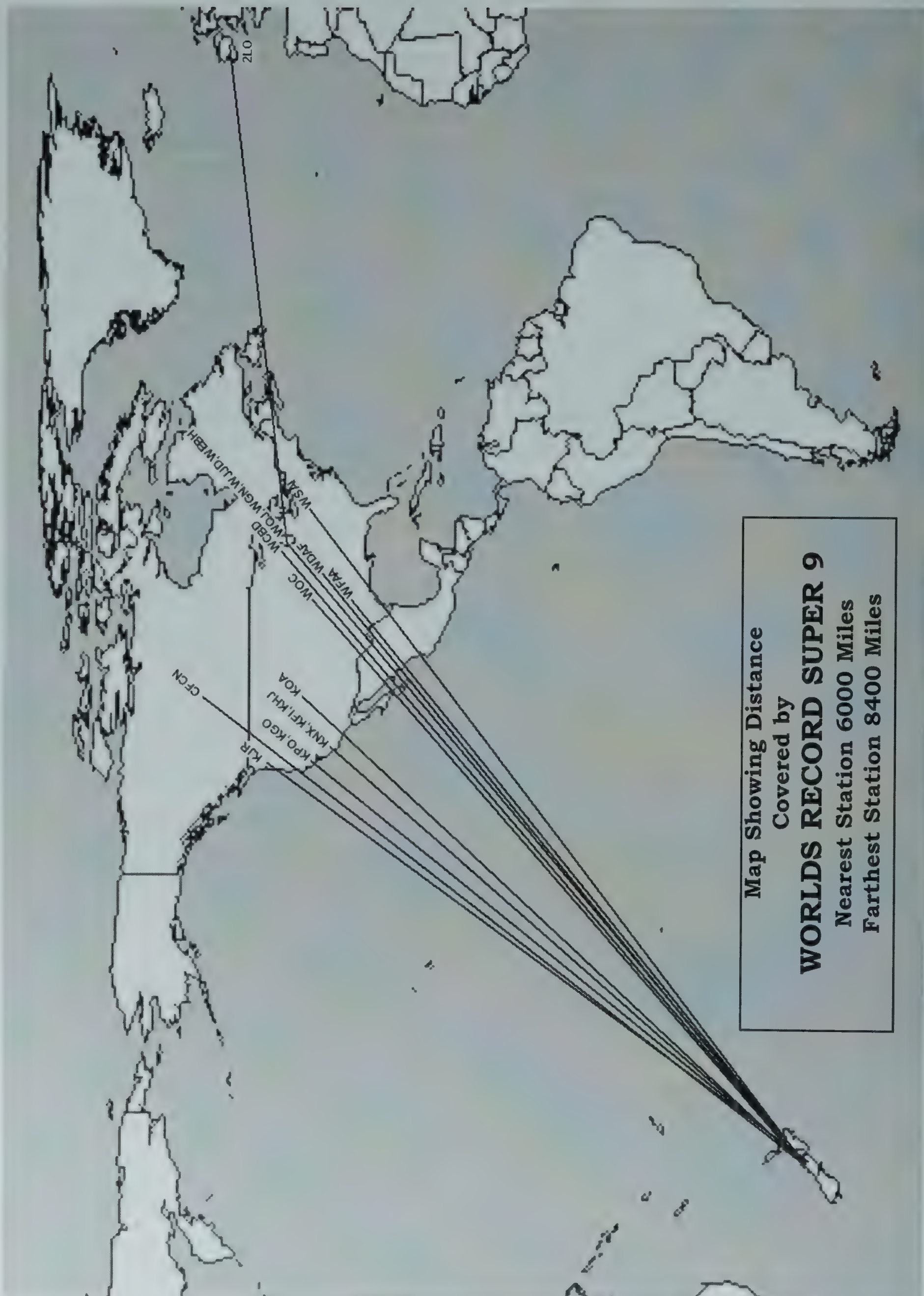
By this time Scott had established an impressive record of listening to more than 100 programs broadcast by nineteen US stations. He had sent his log sheets each week to a newspaper at Wellington, New Zealand. The editor of this paper-the Dominion-wrote to Scott that his was the world's record for reception in New Zealand. Also, he achieved this under adverse conditions of heavy natural static and man-made code interference. The best measure of the difficulty in receiving these AM broadcast stations operating on frequencies of 620 kHz to 1080 kHz with power outputs of 500 to 1000 watts, is indicated by the following tabulation of nights when no US stations were received and nights when only West Coast stations were received.

In summary, more than one-third of the nights from December 27 to January 27 resulted in no US broadcast station reception and about the same ratio applied to West Coast only reception (which was considered somewhat easier than receiving midwestern US stations). In other words on only about one-third of the listening nights were stations beyond the US West Coast received. This tabulation is given not to detract from

| Month | Listening Nights | No U.S. Reception Nights | West Coast Only Reception Nights |
|---|---|---|---|
| December | 5 | 1 | 3 |
| January | 31 | 11 | 16 |
| February | 28 | 14 | 5 |
| March | 27 | 6 | 7 |
| Total | 91 | 32 | 31 |

Scott's record, but as a measure of the difficulties which he faced.

Scott continued his logs up to April 10, 1925, logging stations every night from March 27. Most of them were West Coast, but WHB, Kansas City, Missouri, was added. This addition would have brought the total of US stations up to 20. However, KLA, Cincinnati, was removed from the list given above. This change brought the total back to 19. Also, with no change in the number of stations, KXAA, Cincinnati, was changed to WSAI. KXAA apparently was an experimental call of WSAI. One additional record which Scott set after March 27 was accomplished on March 29, when he logged six US stations over a period of two and one quarter hours. These stations were KGO, KNX, and KHJ on the West Coast; KFRU in Bristow, Oklahoma; KOA in Denver and WEBH in Chicago.


Map Showing Distance
Covered by
WORLDS RECORD SUPER 9
Nearest Station 6000 Miles
Farthest Station 8400 Miles
2LO
WSAI
WFAA
WDAF
WGN,WJJD,WEBH
WCBD
WOC
KOA
KNX,KFI,KHJ
KPO,KGO
KJR
CFCN

# Chapter 4
# The Original Super Nine

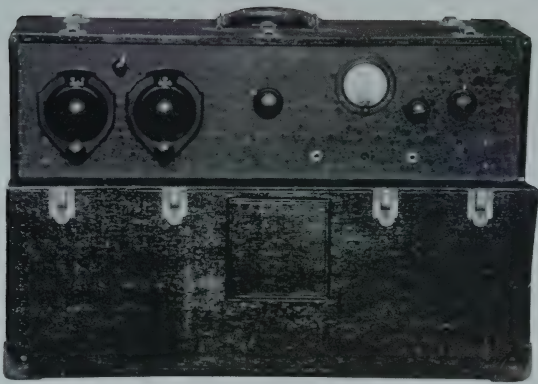
Just after Scott left on the New Zealand trip, the Chicago Evening Post published in early December, 1924, that he had with him an eight tube superheterodyne. Also, in Scott's letter of March 27, 1925, he stated that he was still using the eight tube super and would not trade it for anything he had seen so far. He also reported in that letter the logging of all the stations that he had received up to March 27,1925, which was most of those that he listed in his World's Record claims later. So, the question arises as to how the eight tube superhet was transformed into the World's Record Super Nine. It came about in two ways.

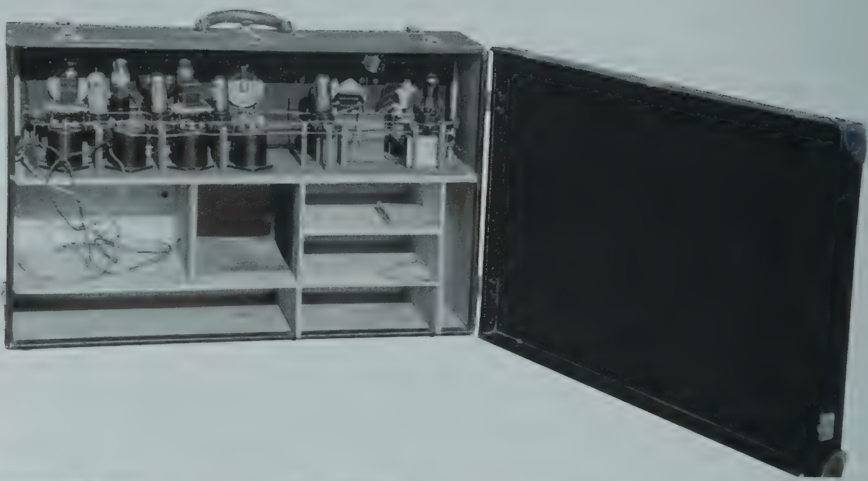
Although Scott did not indicate in any of his letters to station WEBH of the Chicago Evening Post that he thought his set might be a "freak" and that it might not be possible to duplicate it, he could only dispel his doubts by building a duplicate receiver and testing it. So he cabled to Chicago for a duplicate set of parts. Of course, there were no airplanes in 1925 capable of flying these parts to him immediately, so he had to wait about a month for them to arrive and then take the time to put together another set. He expected to leave New Zealand on the return trip to the US by the end of March, but had to stay almost another month to complete the duplicate receiver.

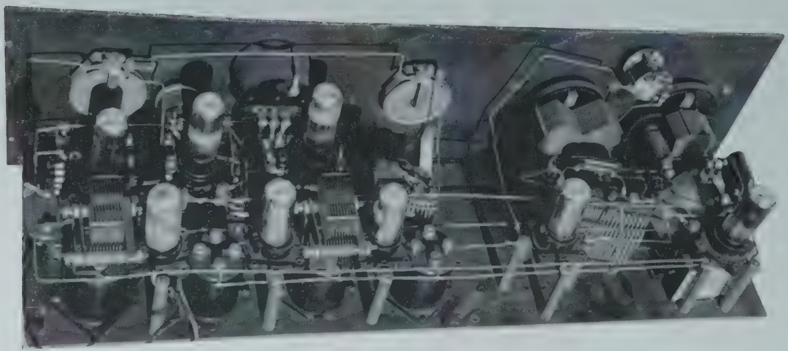
The second factor that entered into changing the set from an eight tube set to a nine tube set was mentioned in Chapter 2. When he left San Francisco he took with him a push-pull amplifier, which was built into a separate box at the Remler factory. He had used this amplifier whenever he wanted to increase loudspeaker volume. However, its use did not affect the sensitivity or selectivity of the basic eight tube receiver and consequently did not affect its ability to receive distant stations. It only increased the loudness of the signals. When Scott built the duplicate receiver, which he intended to leave with his brother-in-law in Tasman, New Zealand, he wanted it also to have some benefit of the additional amplifier especially when loudspeaker volume was desired. However, since he had only one separate push-pull amplifier and since there was no way that it could be fitted into the carrying case of the eight tube receiver, he decided to divide it between the original set and the duplicate. There was no way that he could divide most of the components of the push-pull amplifier, but since there were two tubes in the amplifier he could put one in the original receiver and one in the duplicate receiver. Without adding other components and complicating matters, the simplest thing to do was to connect the additional tube in each receiver in parallel with the audio output tube which was already there. Thus each receiver had two type 199 tubes in parallel in its audio output stage and both sets became World's Record Super Nines.

After building and checking the duplicate receiver in New Zealand, Scott returned to California, arriving there late in May, 1925. One thing that he had not done with the stations in the Los Angeles area was to cable or write to them immediately after receiving them as he had done with the Chicago stations and others in the Midwest and between there and the West Coast. Even though they had been much easier to receive than those farther inland, he still wanted to confirm his reception logs with them and stopped in Los Angeles to do so. The manager of one station, KNX in Hollywood, doubted that Scott could have achieved such consistent reception from his station, which was only a 500 watter. To dispel the doubts from the mind of Mr. Rogers, the KNX manager, Scott asked him to broadcast a test program two nights later to give him time to arrange by cable for his brother-in-law, Mr. Tucker, to try to receive it in Tasman, New Zealand, and report the results. The morning after the test transmission, KNX received a cable giving the gist of the program as received by Mr. Tucker on the duplicate World's Record Super Nine receiver. The details of this reception were reported in the Los Angeles Express, an evening newspaper published there in 1925.

Largely due to the newspaper publicity which he had received in Chicago, Los Angeles, and elsewhere during







**Duplicate World's Record Super Nine**
**Left By E.H. Scott In New Zealand In 1925**
(Photos Courtesy of John Meredith)

and after his return from New Zealand, Scott received many requests from radio fans in all parts of the country for constructional details of the Super Nine receiver after his return to Chicago. To satisfy this demand he prepared a 20-page booklet detailing its construction. By the autumn of 1925 he began to advertise this booklet, referring to it as instructions and blueprints, in national magazines of that day, such as *Radio Age* and *Radio News,* offering it for $5.00 (1925 dollars). In this booklet he outlined a list of parts which should be used to build the receiver but did not offer to sell them. He showed that these parts could be purchased for $103.26. An additional amount of $5.60 was required for drilling and engraving the front panel and $2.00 for drilling the bakelite baseboard. Thus, the total package could be purchased for $110.86. Early in 1926, Scott offered to supply a kit of parts plus the instruction booklet for $89.00. At that time he referred to his business name as The Scott Radio Laboratories at 35 South Dearborn Street, Chicago, Illinois.

Hundreds of the instruction manuals and some kits were sold. Some builders, such as M.F. Beaudoin of Winter, Wisconsin, waxed very enthusiastically about the performance of the set which they had constructed. He wrote, "Constructed World's Record Super 9 with your parts and instructions. On North Woods trip picked up 118 stations in 6 hours. Got Australia, Mexico, Alaska and Cuba. California stations came in like locals. Have tried best receivers made. Yours (The World's Record Super 9) outpoints them all." Despite enthusiasm by some, it appeared that all was not going as well as hoped, because by June 1926, Scott discontinued advertising of the kit. Then he offered the story on the development of the set (which did not include the details of building and operating the set) for a self-addressed stamped envelope. He did mention that the reader should send for data on all parts necessary to make an exact duplicate of the receiver. Apparently, some of those who built the kits were having difficulties in trying to turn them into high performance receivers and a lot of that difficulty centered around the i.f. transformers. He mentioned in the ad at this time that he had facilities for calibrating and matching intermediate frequency transformers and filters to match them. By August, 1926, the ads shrank to about half of an inch. All of which seemed to indicate that this approach to capitalizing on the reception record which had been set in New Zealand was not particularly successful. By November 1926, Scott had a new approach. He went into the i.f. transformer business at 7-9 North Clinton Street in Chicago. Later he located at 7620 Eastlake Terrace.

In an ad in Radio News in November 1926, he first advertised two types of i.f. transformers which took the place of those previously supplied by Remler, labeling them with the brand name SELECTONE. In the same month Radio Age magazine published an article of its own which it titled "Radio Age Adapts World's Record Super to Storage Battery Use." In this article it was written that Radio Age's laboratory had now adapted the receiver (World's Record Super 9) for use with 201-A tubes and by using either a type 112 or type 171 tube in the last stage the necessity of using two tubes in this position has been eliminated. Thus, a World's Record Super 8 was created.

In the list of parts two Selectone I. F. transformers type R400 and two Selectone I.F. transformers type R410 were specified. So it appeared that Scott was willing to let Radio Age redesign his World's Record Super in the way that they saw fit, if it would promote his transformer business. In January 1927, Radio Age published a more detailed article on their World's Record Super 8. Selectone i.f. transformers were again specified in the list of parts. Then Radio Age devoted a full page to the Radio Age World's Record Super 8-Radio's Greatest Receiver-stating all of Scott's records but not mentioning Scott's name. This page was followed by three pages of ads. Scott Transformer was advertised on one page along with five other ads-all of which were for components used in their version of the World's Record Super 8. These parts advertisers included Benjamin for tube sockets, Thor Manufacturing Company for RF couplers, Yaxley for cables, cable connector plugs and air-cooled rheostats, and Thordarson Manufacturing Company for audio transformers.

With this advertising program it appeared that Scott was leaving the kit promotion in the hands of Radio Age magazine in exchange for advertising his i.f. transformers. Apparently, interest in the Radio Age version of the World's Record Super 8 was significant. They followed the January article with another in March 1927, with the title "Building Ideal Model of the World's Record Super 8" by F.A. Hill, Associate Editor of Radio Age. The layout and circuits for this model were copyrighted by Radio Age. In the May-June, 1927 issue of Radio Age, F.A. Hill again published an article titled "Using 9 Tubes on World's Record Super." The additional

# SELECTONE TRANSFORMERS

## *used in* THE WORLD'S RECORD SUPER

### *Which Holds Four Verified World's Records For Reception of Stations 6,000 to 8,000 Miles Distant*

**TYPE B for Sub-Base Mounting**

TYPE B-500. THE NEW SELECTONE HIGH GAIN INTERMEDIATE TRANSFORMER, designed for use with Selectone Twin Filters. Accurately tuned and laboratory matched to a precision of less than one-tenth of one per cent in frequency. Tested for High Gain and voltage amplification which guarantees your reception of DX stations. Price $6.00.

TYPE B-510. THE SELECTONE B-510 FILTER is designed for use with High Gain Intermediate Transformer B-500. It is an accurately tested and matched unit, designed to impart to the receiver the keen tuning and sensitivity necessary in receiving over long distances. Price $6.00.

TYPE B-520. THESE RADIO FREQUENCY COUPLERS, listed as the Selectone RF Couplers, Type E-520, are an innovation in radio frequency design, each matched to within one-third of a turn of uniformity, enabling their use in gang or individually controlled tuning circuits without trouble in balancing. Price $5.00.

TYPE B-530. A SPECIAL SELECTONE ANTENNA COUPLING UNIT designed for use with a Twin set of Selectone B-520 RF Couplers. Has a slightly lower inductance value than the B-520 to permit the use of a small variable trimmer across the secondary in addition to the main tuning capacity, for long distance tuning. Price $5.00.

## Free Book

WE will gladly mail you our booklet "The Story of Selectone Transformers," also complete building instructions on the World's Record Super"—the receiver that brings in DX stations like locals.

**TYPE R for Baseboard Mounting**

TYPE B-540. SELECTONE OSCILLATOR COUPLER. Typifies the same precision construction as all other Selectone products. Price $5.00.

TYPE R-400. THE BASE MOUNTING HIGH GAIN SELECTONE R-400 is famous among radio enthusiasts for its exceptionally high voltage amplification with gratifying stability. Special closed core construction limits stray fields and coupling. Price $6.00.

TYPE R-410. THE SELECTONE BASE MOUNTING FILTER, designed for use with the High Gain R-400 Intermediate Transformer. These filters are precision matched with laboratory equipment and enable 10 kc. separation on local stations with great sensitivity. Price $6.00.

TYPE R-340. THE SELECTONE OSCILLATOR COUPLER, designed especially for use with the R series transformers. Price $3.50.

## *Guaranteed Performance*

*Every Selectone transformer is fully covered by our money back guarantee. You must be satisfied or we return your money. Every set of transformers is given an actual operating test for tone, selectivity and sensitivity (see the photograph below) insuring perfect performance when you build them into your receiver.*

Testing Selectone Radio Frequency Units

Mr. E. H. Scott testing Selectones in special test receiver

Peaking Intermediate Transformers

*Set Builders: The World's Record Super is not only a great DX receiver but also has truly marvelous tone quality. It's easy to build and will out-demonstrate anything you can put against it. Write at once for full information.*

**_The_ SCOTT TRANSFORMER CO., Dept. A, 7620 Eastlake Terrace, Chicago, Ill.**

(Citizen's Radio Call Book - November 1927)

tube was used in an i.f. stage so another Selectone transformer type R400 was added to the circuit. The article stated that the presence of this extra i.f. stage permitted higher amplification of the desired signal without the necessity of forcing the i.f. stages to a state bordering on regeneration. In practice, the added i.f. stage was said to bring in the same stations as the eight tube model but with less distortion and without forcing the receiver to the regenerative state. Again Radio Age copyrighted the layout and the circuit. However, Selectone i.f. transformers were specified for all versions of the Radio Age World's Record Supers, so Scott got the benefit of that promotion.

By May, 1927, there were at least three different World's Record Super 9 versions in existence. There was the first one, which Scott had described in the plans which he sold during 1925 and 1926 for $5.00. This set was a duplicate of the receiver which he had used in New Zealand to set the records on which his initial fame was based. The second one was the version designed by the laboratory of Radio Age magazine. The third one was another nine tube version designed by the laboratory of the Chicago Evening Post newspaper. Basically, the third version was quite similar to the Radio Age model but differed in a few minor respects. While the original model used Remler i.f. transformers, couplers, condensers, etc., the Radio Age and Evening Post models used Scott's Selectone i.f. transformers.

The Evening Post stated that Scott had developed the i.f. transformers to match the storage battery tubes and had to do so because the Remler i.f. transformers were designed to work only with the dry battery 199 type tubes, which were used in the original World's Record Super 9. This contention gave Scott the opportunity to switch away from the Remler transformers to his own gracefully. The only Remler components still used were their twin-rotor condensers. However Remler, which was a Division of the Gray and Danielson Manufacturing Company, took these changes in stride and made the following statement in their ad which appeared in the same issue of the Evening Post:

**REMLER TWIN-ROTOR CONDENSERS**

**Remler Twin-Rotor condensers were used in the original World's Record Receiver that established so many records for long distance reception between New Zealand and the United States. These condensers were chosen because of their ability to bring out the best in any radio circuit. It is significant that this latest model of the World's Record Receiver still uses Remler Twin-Rotor Condensers. Their performance has been proven through a period of years, and they are specified as standard equipment in Radio's best known circuits.**

**The patented Twin-Rotor construction, which permits a rotation of 360 degrees of the dial, assists in the separation of stations which are closely spaced and adds greatly to the selectivity of the receiver.**

**Remler condensers are famous for their performance and are available at your favorite dealer or jobber.**

**REMLER DIVISION OF GRAY AND DANIELSON MANUFACTURING COMPANY NEW YORK SAN FRANCISCO CHICAGO**

On the same page the Scott Transformer Company had an ad for Selectone transformers stating that they offered the highest amplification, finest tone quality and greatest selectivity. Remler's ad indicated that they were glad that Scott was still using their twin-rotor condensers, and were not disturbed that he had gone into business in competition with them at least for i.f. transformers.

Within a period of about six months, four articles for receivers using Scott's Selectone i.f. transformers had appeared in a national magazine and a major evening newspaper in Chicago was featuring a receiver using Selectone transformers. Although Scott had relinquished some of his proprietary rights to the World's Record Super receiver, he was coming off well as far as publicity was concerned. If he had tried to be more secretive about the receiver circuitry, he would probably have received very little publicity. Also, it appears doubtful whether he could have done much more than copyright the circuit diagram and the value of that step might have been dubious.

## The World's Record Super Ten Receiver

By October 1927, Scott was taking the ball back as far as a complete receiver was concerned. He had designed a new receiver, which he called the World's Record Super 10. That month Radio Age published an article titled "The New World's Record Super 10". Instead

of disregarding Scott as they had with their World's Record Super 8 and Super 9 receiver, they stated that this article was appearing through the courtesy of E.H. Scott. Along with the article appeared a two page ad titled "Build Radio's Greatest DX Receiver- New World's Record Super 10". Although the ad was by Scott Transformer Company, it returned the emphasis to the complete receiver instead of just i.f. transformers in so far as Scott was concerned.

When Scott built the receiver for his New Zealand trip, the main considerations were sensitivity and selectivity. The Radio Age Super 8, the Ideal Super 8 and Super 9 and the Evening Post Super 9 were not true reflections of Scott's attitude toward a radio receiver that was to bear his name. As Radio Age magazine stated, their models were designed in their laboratory. The Chicago Evening Post said essentially the same thing, although they said that their version outperformed the original Super 9. However, undoubtedly, Scott had a hand in all of them. The World's Record Super 10 marked the initiation of appearance, quality and performance standards for which Scott was to become noted throughout his career in the radio business.

Writing about the Scott World's Record Super 10, which was done through the courtesy of E.H. Scott of the Scott Transformer Company, Felix Anderson of Radio Age wrote:

"....it is a truly pretty bit of radio design. Striking in appearance, the front panel controls kept down to a minimum consistent with efficiency, the receiver as a whole has that finished business-like appearance that all set builders strive to attain. The back panel is equally neat in appearance, having a symmetrical and systematic arrangement of the parts, so intriguing that even the most sophisticated radio engineer will stop to admire the effect."

The Super 10 required a large number of r.f. and i.f. transformers-six in all, which fit in fine with the Scott Transformer Company, which made all of them under the brand name of Selectone. Anderson wrote,"These new units are the heart of the World's Record Super 10 and are the result of more than five years of constant test and experiment in an effort to obtain the optimum in efficiency, appearance, and sensitivity. Housed in highly polished bakelite casings, all of the same appearance, they stand majestically like soldiers in a row, each of them designed to do their utmost in intercepting and amplifying weak and distant signals as well as those of local transmitters."

Continuing, he wrote,"All these new units are laboratory matched products. While the World's Record Super 10 is a receiver made of laboratory equipment, it must not be considered as an experiment. Each unit is closely matched and peaked, and every Selectone unit is held to a rigid standard of performance, uniformity and efficiency. The assembly of such units into a working equipment is obviously rewarded with crowning and brilliant result."

Then he wrote, "Many radio enthusiasts fail to fully appreciate the importance of good intermediate frequency transformers, which is why the superheterodyne has been long considered as a complicated and difficult receiver to construct and operate satisfactorily. This erroneous conception is far from true. If the intermediate frequency transformers are really matched for peak frequency, regeneration and amplification, and if they are intelligently designed and wound to give the greatest sensitivity and selectivity with tone quality, the superheterodyne becomes only a matter of the assembly of a few more pieces of equipment than the ordinary receiver with considerably greater efficiency and enjoyment." Anderson went on to tell how the Selectone units were matched and tested in their manufacture and then finally dropped into proper place in a test receiver for an air check involving selectivity, distance-getting ability and tone quality before leaving Scott's laboratory.

The World's Record Super 10 consisted of two r.f. stages, a first detector, oscillator, three i.f. stages, a second detector and two audio stages with a separate B battery eliminator. It represented the ultimate in Scott's design effort prior to the introduction of the screen grid tube. In the same issue of Radio Age in which the above article appeared, Scott ran a two page ad presenting the Super 10 as a kit. The ad included a list of parts at a total price of $137.80 not including the ten tubes. Of this total there was $44.00 worth of Selectone components furnished by Scott Transformer Company, including an antenna coupler and oscillator unit in addition to the six i.f. and r.f. transformers mentioned above. There was also $30.80 worth of Remler components, including their 3-in-line ganged condenser, their 360 degree condenser, two drum dials and two r.f. chokes. Also, three Thordarson audio transformers added up to $22.00. Scott had used Thordarson audio transformers in the original World's Record Super 9 and continued to use them in the Super 10. The other major items were a Jewel voltmeter at $7.00 and ten Benjamin

BULLETIN NO. 7

REMLER

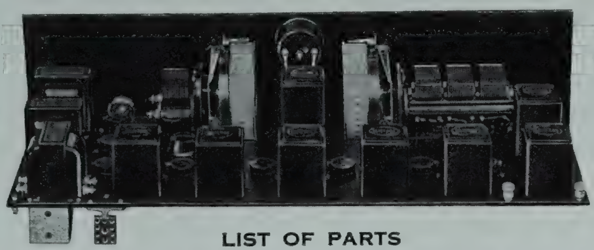
PAGE______
SECTION______
APRIL 1, 1928

# SERVICE FOR SET BUILDERS

GRAY & DANIELSON MANUFACTURING CO., 260 FIRST STREET, SAN FRANCISCO, CALIF.

## NEW WORLD'S RECORD SUPER 10

**BLUE PRINTS NO. 80**
**$1.50**
FURNISHED BY
CITIZENS RADIO SERVICE BUREAU
508 SO. DEARBORN ST.
CHICAGO



**SELECTONE UNITS**
MANUFACTURED BY
SCOTT TRANSFORMER COMPANY
7626 EASTLAKE TERRACE
CHICAGO

### LIST OF PARTS

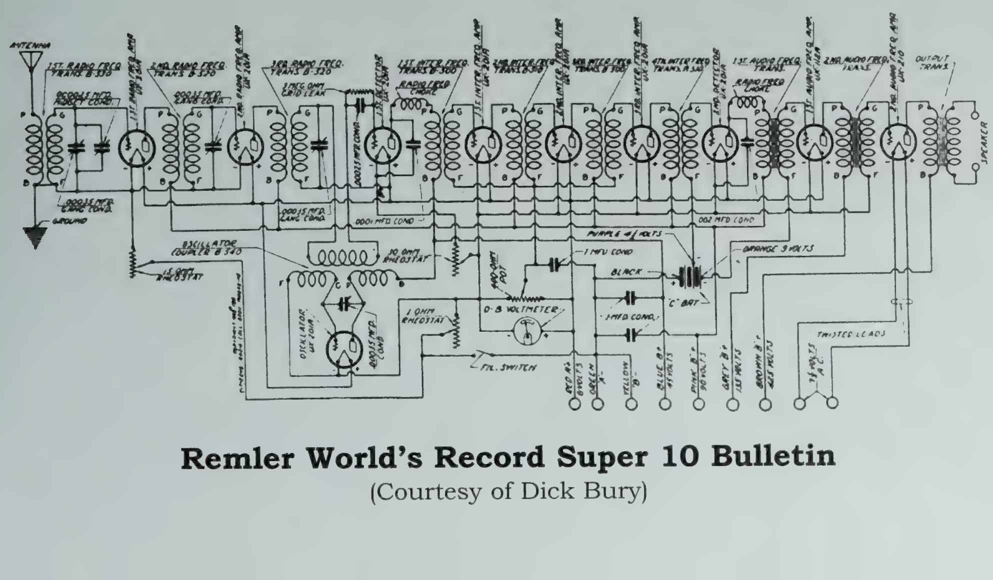
| | | | |
|---|---|---|---|
| 2 | Selectone No. B500 L. W. Transformers | $ 6.00 | $ 12.00 |
| 2 | Selectone No. B510 L. W. Transformers | 6.00 | 12.00 |
| 2 | Selectone No. B520 R. F. Transformers | 5.00 | 10.00 |
| 1 | Selectone No. B530 Antenna Coupler | .... | 5.00 |
| 1 | Selectone No. B540 Oscillator Coupler | | 5.00 |
| 1 | REMLER No. 633 .00035 Three-in-Line Condenser | | 15.00 |
| 1 | REMLER No. 638 .00035 Twin-Rotor Condenser | | 5.00 |
| 2 | REMLER No. 110 Drum Dials | 4.50 | 9.00 |
| 2 | REMLER No. 35 Choke Coils | .90 | 1.80 |
| 10 | Benjamin No. 425 Sub-Panel Sockets | .50 | 5.00 |
| 1 | Benjamin No. 8629 Set of Brackets | .... | .75 |
| 1 | Frost No. 1824 Bakelite 400 Ohm Potentiometer | | 1.25 |
| 1 | Frost No. 1802 2 Ohm Heavy Duty Rheostat | .... | 1.00 |
| 1 | Frost No. S1815 15 Ohm Rheostat with Switch | .... | 1.35 |
| 1 | Frost No. 1830 30 Ohm Bakelite Rheostat | .... | 1.00 |
| 2 | Frost No. 253 Tip Jacks | .15 | .30 |

| | | | |
|---|---|---|---|
| 1 | Silver-Marshall No. 340 Balancing Condenser | .... | 1.50 |
| 1 | Jewel No. 135 Voltmeter, 0 to 8 Volts | .... | 7.00 |
| 3 | Tobe 1 Mfd. By-Pass Condensers | .90 | 2.70 |
| 1 | Tobe 3 Megohm Grid Leak | .... | .50 |
| 2 | Thordarson Type R200 Audio Transformers | 8.00 | 16.00 |
| 1 | Thordarson Type R76 Output Transformer | .... | 6.00 |
| 1 | Carter .00025 Mfd. Grid Condenser (with Clips) | | .50 |
| 1 | Carter .002 Mfd. Fixed Condenser | .... | .50 |
| 1 | Carter .0001 Mfd. Fixed Condenser | .... | .40 |
| 1 | Jones Type B. M. 10 Contact Cable and Plug | | 3.50 |
| 40 | Kellogg Solder Lugs | .... | .25 |
| 1 | Formica Panel, 7x26, Drilled and Engraved | | 6.70 |
| 1 | Formica Sub-Panel, 10x25, Drilled | .... | 7.00 |
| | Total List Price | | $138.00 |

RMA

SOLD THROUGH JOBBERS

FOR DESCRIPTION SEE OTHER SIDE



**Remler World's Record Super 10 Bulletin**
(Courtesy of Dick Bury)

tube sockets at $5.00. The components detailed above made up about 80% of the total price of $137.80.

The ad stated that the Super 10 was easy to build; quoting "the only tools required are a screw driver, pliers and a soldering iron. The building instructions and the full size blueprints show exactly where to place each part and how to run every connection and are so simple and easy to follow that anyone, even without previous experience in building a radio receiver, can duplicate this marvelous receiver and own the finest radio set available today." In the December-January 1927-28 issue of Radio Age, Scott ran another two page ad, which included some testimonial letters from fans who had built and used the Super 10. The ad stressed that although the set may appear complicated, it could be easily built in a few hours.

The Citizen's Radio Call Book published details on most of the circuits being constructed during that period and their laboratory had to maintain a degree of impartiality. They made the following appraisal of Scott's World Record Super 10:

"The World's Record Super 10 is a radio receiver designed to meet the trying conditions of present-day broadcasting. Yet it is so flexible in design that it will serve as the standard of comparison for years to come. It is all that the most exacting and discriminating enthusiast can expect and desire from a radio receiver."

# Chapter 5

# The Shield Grid Nine and the Custom Builders

## A Radio for Custom Builders

Even as Scott was reaching a peak in the advertising of his World's Record Super 10, there were changes in the wind. By the autumn of 1927, it was reported that RCA would place a new four element tube on the market before the end of that year. That tube, to be known as the screen grid or shield grid type, was the result of developmental work carried out by Dr. Hull of the General Electric Company. In this tube the plate to control grid capacity was reduced to a negligible level by the action of an added grid surrounding the control grid. This reduction of capacity meant that the tube was effectively self–neutralized and that it could provide much higher stable gain than the 201-A triode which was widely used at that time. Amplification gains as high as 200 were obtained experimentally at 50 kHz. It was apparent that these tubes would be excellent i.f. amplifiers due to their high gain factor. RCA designated the tube as the UX-222.

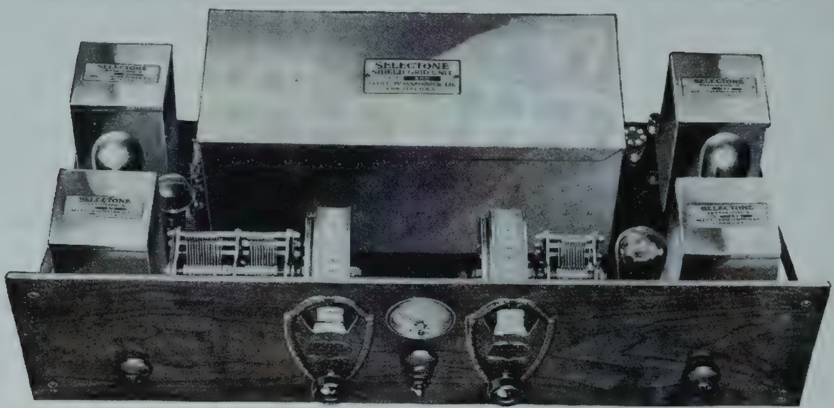
Scott realized that a tube which had such promise as an i.f. amplifier was bound to have a significant impact on superheterodyne design. So he made the development of a receiver to utilize it a high priority project. After almost eight months of work in his laboratory he introduced the Scott Shield Grid 9 receiver in the May 1928, issue of Radio News. Later that year he said a straight superheterodyne is a comparatively simple proposition. However, when you combine within the superheterodyne a radio frequency amplifier ahead of the first detector, short wave reception (which he was already getting into as covered in the next chapter) and complete shielding of the receiver with screen grid tubes in the intermediate amplifier, you have a proposition that requires a very considerable amount of intensive laboratory work to perfect. Except for the i.f. stages, where three of UX-222 tubes were used, the remainder of the set was equipped with the currently conventional types such the -OIAs in the r.f. stages and 2nd detector circuit and a-112A in the audio stage. A separate power amplifier and power supply used a type 250 in a final audio stage and two type 281 rectifiers. If battery operated, this receiver could be used without the separate amplifier. In that mode, it was an eight tube receiver. However, Scott liked plenty of audio and preferred to use the set with the separate amplifier resulting in a nine tube set. By adding the two rectifiers it could have been called an eleven tube set.

Comparing the Shield Grid 9 with the Super 10 of the previous season, Scott wrote:

> **"The man who buys a custom built receiver buys it to obtain more distance and greater selectivity than is possible with any manufactured receiver he can buy. We, therefore, have always endeavored to make every model we bring out the most powerful set it is possible to build.**
>
> **Last season we pioneered with two stages of tuned radio frequency ahead of the first detector with a three stage i.f. amplifier using 201A tubes. This receiver was extremely efficient. In fact, there are people who come up to the laboratory practically everyday who own one of the last year's models and who say they do not believe anything can be built that is better than the World's Record Super 10 for it has perfect tone quality with great DX range. However, when they have actually listened to the new Scott World Record Shield Grid Nine, they realize the seemingly impossible has been accomplished, for their new receiver is actually more powerful than last year's model and has, if anything, even better tone with much greater selectivity."**

Scott went on to explain that he preferred to have an R.F. stage ahead of the first detector and that he preferred to feed this stage with an outdoor antenna rather than a loop antenna. In the Shield Grid 9 all of the components of the three i.f. amplifiers were assembled into a lacquered copper can to provide adequate shielding. The i.f. coupling units were designed so that a very high stage gain was obtained with ample

# SCOTT'S World's Record
# *SHIELD GRID NINE*




# *Radio's Greatest DX Performer*

## Gives You Hair-Line Selectivity -- Wonderful Tone -- Tremendous Volume

For three years the Scott World's Record Receiver has challenged the world of radio to equal its amazing performance. Today the challenge is still unanswered!

If ever, the ultimate in radio has been attained—here it is!—in the NEW Scott Shield Grid Nine. The New Scott Nine is the logical development of the famous original Scott World's Record Receiver, which during a test of three months established FOUR WORLD'S RECORDS on distant reception, and brought in stations night after night 6,000 to 8,000 miles distant. This New Scott Receiver provides reception such as only the fine *custom-built* set can offer—reception such as you have only to hear *once* to realize that this wonderful receiver is fully years in advance of radio development today.

### 4 Hours to Build

Here's a set with no tricky adjustments. You can build it in 4 hours easily. Panel and sub-panel are drilled to receive each part. Simply wire it up—plug in—and you have your receiver operating at maximum efficiency. Shielded Grid Amplifier Unit comes fully tested and wired. Transformers are perfectly matched, with no exterior adjustments to make.

### Tuned R. F. and Shield Grid Long Wave R. F. Give Amazing Results

The output of the Scott Shield Grid Nine is much greater than the average good "super" for two fundamental reasons. First, the completely shielded stage of high gain T. R. F. delivers an input to the Shield Grid Amplifier equivalent to the output of the best 4-tube T. R. F. receivers. This gives the Shield Grid Amplifier a much stronger signal to work with, than in the ordinary straight "super"—a tremendous advantage obtainable in no other "super." The second reason for the greater output, is the design, construction and complete scientific shielding of the Scott Shield Grid Long Range Amplifier, affording this unit a far greater amplification factor than any existing screen grid long range amplifier.

### Extreme Selectivity *Always Obtainable*

The tremendous output of the New Scott means extreme selectivity—not "fussy" uncertain selectivity, but razor-edge sensivity obtained in a stable circuit condition with tubes operated at normal voltage.

### Precision Matching of Parts

The *New* Scott uses shield grid tubes in an improved circuit with new power pack and amplifier. All parts of this amazing receiver are designed especially for this set, and are matched with absolute precision. The extreme care taken in testing and matching of parts is one of the reasons why the New Scott outperforms in all competitive tests of distances, selectivity, volume and tone. All stations come in at one point only on the dial; a further improvement is evidenced in the fact that both dials track together.

### SET BUILDERS

**SELL in a Protected Market**

Set builders should read every word of Mr. Scott's statement which appears on page four and five. This is a serious situation. If you are to build up a permanent, prosperous radio business for yourself, you must have the kind of support that Scott gives you. You can't afford to spend time, effort and ability building up a demand in your community only to have it supplied through net-price catalogs.

**Get Behind This Fine Receiver**

It sells on demonstration. We help you to secure and bring in prospects through our elaborate sales plan, which includes mailing folders with your name imprinted, a special Sales Manual and other sales helps. Tie up with the Scott Plan. Make each day build for the future, toward the day when you will have a real, genuine established business.

### Low Operating Cost

The *New* Scott Shield Grid Nine can be economically operated with dry batteries, and will give ample volume for the average home. The eight tubes incorporated in the receiver draw only 29 mils. Maximum volume is obtained by the use of the Scott Power Pack and Amplifier incorporating the ninth tube for the second stage of audio. This is the latest 250 power tube giving tremendous volume with perfect tone quality.

*We Guarantee that you can build the New Scott Nine and get the same results we obtain from our Laboratory Models.*

### FREE Circuit Diagram and Particulars

Write at once for full particulars! Get the facts about this amazing new world's record receiver—its low cost—limitless range—tremendous power—10 kilocycle "razor-edge" selectivity. Build this set and enjoy radio at its best! Free Circuit diagrams. Also copies of 6,000 to 9,000 mile reception verification. Mail coupon today for the interesting information.

**—Mail This Today—**

C. B. 11

**Scott Transformer Co.**
**4448 Ravenswood Ave., Chicago, Ill.**

Please send me FREE circuit diagram, records and full particulars of this new Scott Shield Grid Nine.

☐ I am interested in your proposition to professional set builders.

*Name* ..............................

*Street* ..............................

*Town* ..............................

*State* ..............................

## SCOTT TRANSFORMER CO.

**4448 Ravenswood Avenue • • • • CHICAGO, ILL.**

(Citizen's Radio Call Book - November 1928 )

selectivity. In the Shield Grid 9 the i.f. gain was indicated to be 140 per stage. A balance was struck between adjacent channel selectivity and a bandwidth adequate for good tone quality. The i.f. stages were followed by a second detector using plate rectification, which was much less likely to overload than a grid-leak type second detector.

Scott continued to supply the i.f. and r.f. transformers under Selectone label, but in the Shield Grid 9 went a step further and had practically all of the other components made with the Selectone label. For instance, all of the variable condensers and all of audio transformers as well as the power transformer, filter choke and condenser block of the power amplifier and power supply unit bore the Selectone label. Scott Transformer Company did not manufacture any of the above components except the i.f. and r.f. units. However, the suppliers of the other components were quite willing to supply them under the Selectone label. The price of a complete set of parts for the Shield Grid 9 was $138.10. The Power Amplifier and Power Supply, furnished separately, consisted of components at a list price of $83.00. Fitted with plug-in r.f. and oscillator coils, the Shield Grid 9 was equipped for short-wave as well as broadcast band reception. Its short wave operation will be discussed in Chapter 6.

Scott said that the Shield Grid 9 kit could be turned into a completed receiver in not more than four hours. Since the i.f. amplifier was completely packaged and all of the other parts could be mounted within about one hour, the total of four hours did not seem unreasonable. The separate power amplifier and supply was also fairly easy to assemble. Because of its high performance capability when compared with earlier Scott models, it would appear to have been an ideal set for the home constructor and Scott spared no effort to use pictorial wiring diagrams to the fullest extent. However, rather than rely on the home constructor market alone, Scott decided that it was an ideal vehicle for testing the custom-builder market. Custom-builders had been around almost since the inception of the Superheterodyne kit, because home constructors had so much difficulty with this more complex circuitry. But like many phases of radio and electronics which have lingered for awhile to burst forth later, custom building of home receivers did not really take off until late 1927 and early 1928. Scott saw custom building as the ideal way to get to a wide range of the public with his higher quality products. He decided to use the Shield Grid 9 as the vehicle to propel him into that market.

## The Custom Radio Market

In early 1928 there were about 200,000 people in this country who would immediately start building sets containing new circuits after they were described in national radio magazines. There was also another group of about the same size who followed these magazines for the latest radio circuits and improvements and who desired to have sets containing them. However, they had neither the time nor inclination to build them. They usually had a professional custom set builder make a receiver to satisfy their interest. There was a variety of reasons why custom set building appealed to many people. One reason was that the customer might want a receiver that would fit into a certain piece of furniture and could not find a manufactured unit to meet the requirements. Special installations were a fertile field for custom set builders. These varied from a number of loudspeaker outlets around a large home or estate to a hotel or restaurant where even more outlets were required. Some wealthy people might want a custom-built radio receiver for the same reason that they might want a custom-built automobile.

Another perhaps more basic reason for having a custom-built set was to obtain a better radio receiver than one could find among manufactured sets. Such a custom built set would have greater sensitivity, sharper selectivity, and better tone quality. While Scott was in a position to practice custom building for special configurations and installations, he was also interested in receivers which would give better performance than anything that could be obtained from a production-line manufacturer. Most manufacturers, trying to capture the largest possible market share, let price dictate and consequently built an average set. Scott's philosophy was to strive for the ultimate in performance regardless of cost.

Custom set builders began to appear in greater numbers during the last half of 1927. By 1928 thousands of them were following the philosophy of building a better or best receiver. In general, they were a group of individuals who built sets for friends and others whose confidence they had gained. They were the service men of their community; repairing and replacing parts and always being called in case of trouble. They could be classed in two groups. One group built sets only during their spare time, while the other group devoted their entire time to the business. In either case, a considerable amount was spent in the

construction of the sets.

The part time group averaged from two to five sets per month, expending from $150 to approximately $750 over the same period. The full time group averaged from five to fifteen or more sets per month. This estimate was said to be conservative. All sections of the country had their groups of custom set builders. They would build the sets which gave the best performance and the least trouble. These had to be receivers with which they were the most familiar and on which they could obtain all of the information which they required.

One of the better known custom set builders was H. Horneij of the Schneider-Horneij Radio Research Laboratories (a former commercial radio operator) in New York City, who was building approximately 500 sets annually. All receivers were built to meet customer requirements, and only after careful consideration of where they were to be used. Only the very best circuits were employed, and long experience facilitated the coordination of circuitry and parts location. Mr. Horneij said that every part was thoroughly tested before assembly and the finished set was subjected to rigid tests by him personally.

Another custom builder was H.C. Sherer, who operated the Montclair Radio Laboratories on a part-time basis. He had been in the business since 1925. His motto was "In the Business to Produce the Best." He often built sets for customers as far distant as North Carolina. Most of his clients, he said, were discriminating buyers who knew what they wanted, and also realized that a good set, though it may cost a bit more in the beginning, will ultimately prove more economical than a cheap one. He expressed the belief that the custom built receiver of that period was at least one year ahead of its manufactured brother. It was even further ahead than that when it came to superheterodynes, because in the 1920's there was no manufactured brother except RCA.

Another former radio operator in the custom set business was John V. Kitchen of Brooklyn, N.Y. He was said to have taken up custom radio building, because he discovered that remarkable DX feats could be achieved with makeshift receivers which he had built. Their performance spurred him on to build more elaborate receivers using the best parts and to ultimately sell them to customers willing to pay the price.

With a background of science teaching, W.H. Kuhlman of Lakewood, New Jersey was another example. Starting in 1924 by building his own set, by 1928 he was a full-fledged custom builder using only circuits and materials which his experience had shown to be superior.

One major advantage of the custom built receivers was that they could be arranged so that they could be installed in a cabinet of any style that the customer might choose as well as in closets or behind walls so that no cabinet was even required. This concept has survived to this day. A good example of a company offering such services was Boulton Music Systems of New York City, which sold digital audio installations through full page ads in the New York Times Sunday Magazine. Also, the need for servicing could be kept to a minimum through the careful selection of parts and the superior construction methods of the custom builder.

During 1928 Scott issued a 50-page booklet titled "How to Sell Good Custom Built Radio-The Scott Plan." The first seventeen pages dealt with Scott history and covered the Shield Grid Nine in some detail. The remainder of the booklet dealt with the Scott Plan. It was stated that he was selling directly to the set builder and not through jobbers, whom he had used previously. He was also protecting the custom set builder by insuring that Scott receivers could not be bought at some lower price than the set builder could offer to the customer. He offered a Scott franchise to any custom builder who could prove that he had built five receivers, including one Scott World's Record Super. Proof was given by furnishing Scott with the names and addresses of the purchasers of these five sets. Upon receipt of this information, Scott said that Scott Transformer Company would write to these owners to determine whether they were satisfied in every way with these sets. If so, the franchise would be granted to the builder who had applied for such recognition.

In a sort of an interlude, Scott showed five cabinets, which could be supplied for the use of the custom builder, on pages 24 and 25 of his booklet. These were, of course, drilled and dimensioned to accommodate the Shield Grid Nine. On the following pages Scott went on to tell how one could start a Custom Building Business by lining up prospects and organizing a small workshop. He also offered to supply stationery, cards, advertising copy and suggested ways to get free newspaper publicity. He then dealt rather extensively with demonstrations of the receivers in various settings. He also indicated that he would treat franchised Scott builders like they were branches of his company. He offered to help with form letters which could be used by the custom builder in mailings to prospects in the area. He devoted four

pages of questions and answers to the specific demonstration of the Shield Grid Nine receiver. Then he covered what he called the "Untouched Market for Good Custom Built Radio." Here he was referring to hotel, restaurant, waiting room and store installations. He included a copy of a letter from the Chicago and North Western Railway Company in which he was thanked for the installation of Shield Grid Nine receivers in the club cars of several of their trains in time to hear election returns on November 6, 1928. This was an example of Scott's own custom building efforts. It is said that he worked overtime to build these ten sets in time for the election.

With the expansion of custom building activity around the country and Scott's own custom building activity it became necessary to seek larger quarters for the company. In mid-1928, the Scott Transformer Company moved to 4450 North Ravenswood Avenue in Chicago, where the company was to remain until 1945. At this address, a three story building was adequate for the company to organize properly. The research and development laboratory along with the construction and test department were located on the third floor. General offices and demonstration studios were on the second floor and the foreign department, which handled mail orders from overseas, was located on the first floor. When Scott returned from New Zealand in 1925, he called his company Scott Radio Laboratories, but in 1926 changed to the Scott Transformer Company as he concentrated on matched i.f. transformers. By 1928 when the move was made to Ravenswood Avenue the activity was swinging back to complete

**Scott Radio Laboratories**
**4450 North Ravenswood Avenue - Chicago**

kits and receivers. The name of the company was changed to the E.H. Scott Radio Laboratories in 1931.

## The Custom Set Builders and the Patent Situation

Until 1927, most of the major receiver manufacturers succeeded in resisting RCA's legal actions to force them to license under its patents. This delaying defense was due in part to the complaint issued against the Big Radio Group of companies (RCA, General Electric, Westinghouse, Western Electric, AT&T, International Radio Telegraph Company, United Fruit Company and the Wireless Specialty Company) by the Federal Trade Commission in January, 1924. They had some reason to believe that the government might restrict what most of the industry saw as RCA's obviously monopolistic control of radio receiver patents. Although the Federal Trade Commission held hearings with the Big Radio Group regarding alleged monopolistic practices, the US Justice Department did not file a suit against them during the 1920's. Since RCA was not deterred by mere complaints, hearings and wrist-slapping by the Federal government, it pursued vigorously by legal means its efforts to force its competitors into patent licensing agreements or settlements.

By 1927, many of RCA's competitors succumbed and month after month during that year licensing agreements and settlements between major radio companies of that day and RCA were announced. First, there was the Crosley Radio Corporation, followed by Murdock and Charles Freshman. Then Atwater Kent became an RCA licensee in what was referred to as the settlement of the most important case in the history of radio patent litigation as of that date. Then Mohawk, Day-Fan, Federal Radio Corporation and A.H. Grebe fell into line to become RCA licensees. Many of these companies also held a Hazeltine license, which was based originally on Dr. L.A. Hazeltine's neutrodyne patent. However, the introduction of the screen grid tube mitigated the need for neutralization. So its use declined, but the Hazeltine Corporation amassed a number of patents, which it bought in many cases, and became a patent holding company using the same business approach on licensing as RCA.

The RCA license made available the use of more than 140 radio patents held by RCA, GE, Westinghouse and AT&T for royalty payments of 7½ % based on sales at the manufacturer's level. An added clause in the

# The Lid Ripped Off "Back-Door" Selling in Custom-built Radio

## *We Start a Firm Foundation For This Business!*

E. H. SCOTT

The radio industry has grown up "over night." Changes in the art and readjustments in distribution methods have been swift and revolutionary. What was accepted practice yesterday is taboo today.

First we had the era of the "home-built" receiver. The fan bought his parts where he could find them and put them together as best he could. Then, out of the ranks of these fans came a distinct new type of business man—the Professional Custom radio set-builder, men who made all or a large part of their living from building and selling radio sets.

About the time the professional custom set-builder was getting a footing in the radio field, the quantity production factory-built receiver came into the market. Large capital was attracted and great factories sprung up for the manufacture of radio receivers. Huge advertising appropriations and elaborate nation-wide selling campaigns were put behind them.

### Unhealthy Practices Spring Up!

Radio sets were produced by the hundreds of thousands and the custom set-builder now had to compete with the factory built sets. Not only this but at the same time a complete new set of selling tactics sprung up in the distribution of radio parts.

Millions of net price catalogs were suddenly sent broadcast to the public by some of the so-called "Jobbers." The situation has gradually gotten worse and at the present time anyone can walk into a very large number of the "Jobbers" and buy all the parts they want at "dealer's" prices. List prices have become a joke.

Not only this, but an examination of the principal mail order catalogs will show that the larger part of the space in them is this year given to the display of their own private brand completed set with the NET or discounted price prominently displayed. You can reach no other conclusion, therefore, that a large number of "jobbers" are gradually switching their efforts to the establishment of a market for their own particular private brand factory constructed receivers. With this policy we have no quarrel, everyone has a perfect right to conduct their business as they see fit. But our business lies in developing the custom set-builder, and there is no doubt at all but that the custom set-builder will be a non-existent party before long, if he is compelled to compete against the factory built set, sold to anyone who wants to buy one at WHOLESALE price. Think it over. *What chance has the custom set-builder of building up a permanent business with merchandise, either kits or completed sets, that his customers can buy at the same price as he can?*

In what other business have we the same conditions that now prevail in the radio parts business. What commodity can the general public buy at the same price the dealer pays for it? If you want to buy furniture, an automobile or a suit of clothes, you go into a retail store and pay list price for it, if you are not a dealer. As far as I know, the radio parts business is the only business of any size in the country in which the general public can buy merchandise at the same price as the dealer.

### The Future—and the Custom Set-Builder

During the last three years we have developed what we consider the finest custom-built radio receiver on the market. We have a nation-wide organization of professional set-builders to construct and sell our receivers. A number of these men are now earning their living exclusively in this way and we see in them the future of both our own and the business of custom-built radio receivers.

We have, until recently, gone along the conventional trade channels, selling our products to the jobbers who, in turn, distributed them to the professional set-builder and local dealer. As has been the custom for several years, we allowed our receivers to be listed in the catalogs of the jobbers. Since these were principally list price catalogs with their circulation supposed to be restricted to established dealers and professional set-builders, this was a perfectly legitimate move. Even today there still are hundreds of legitimate jobbers who issue only list price catalogs and jealously guard their circulation. With this kind of jobber we have no quarrel and will continue to distribute our products through him.

But, during the past year or eighteen months there seems to have been a veritable epidemic of net-price "jobber" catalogs which have been indiscriminately circulated to the public. While the professional set-builder came through the frontdoor, the net price catalogs entered the back door. The business of the professional set-builder was threatened. All his work is going for naught when his customers can buy at the same discounts at which he has to purchase. His biggest source of income is about cut off and his work reduced to a matter of "Service" and "Installation"—steps that

would not allow him sufficient return for his efforts.

## We Take Drastic Steps to Protect the Professional Set-Builder

Our own organization of set-builders were quick to warn us of the danger of this situation. Therefore, we have taken a drastic step to protect them. We have cut the so-called net-price-catalog-jobber, who distributes his catalogs indiscriminately, entirely out of our distribution system. Hereafter no "Scott" receiver will be listed in any net price catalog. Nor, if we can help it, will they be sold over the counter by any so-called "Jobber" who makes a practice of selling to the public at dealers' discounts. The entire wholesale trade has been so advised and just as soon as all present issues of net-price catalogs listing our line have run their course, our contact with jobbers who sell to the general public at discount prices is ended forever. Only set-builders and dealers will be able to purchase at discounted or net-prices.

## A Comprehensive Plan of Support

We believe in custom-built radio. The finest things are always handmade and there are millions of homes that will have nothing but the best and are quite willing to pay for it.

Our first job has been to produce a receiver that will satisfy this demand. Our second problem was to build up a nation-wide staff of "Scott" builders to construct and sell these fine receivers. We now have hundreds of such men in every state in the Union and in some foreign countries. These are men qualified by skill and business ability to do a creditable job of distributing "Scott" receivers to the public.

In organizing and co-operating with this staff of "Scott" dealers or builders, our efforts have not stopped in providing a good product and fair competitive marketing conditions. We back up our builders with a complete, elaborate selling campaign. We have a beautiful, hard-hitting series of folders on which we will imprint the set-builder's or dealer's name. An extensive advertising campaign is conducted to further popularize and push the sale of "Scott" receivers. A sales manual and daily correspondence, contests, etc., form a background of real support to authorized "Scott" builders. Never before, to our knowledge, has any kit manufacturer gone so far in the support of his retail outlets.

## Let's Put This Business on a Firm Footing!

We call on all forward-looking professional set-builders and all other manufacturers in this field to support this movement to protect the custom-built radio retail market. If we are to make of this a substantial, lasting business, it must find its foundation on time-tried, common sense, proven policies; *protecting the legitimate established set-builders, or the man who wants to get into this business.* He must be able to go to his customer with full faith that he can demand and get fair retail prices. In no other way can he be assured of a living margin of profit.

We know what we are talking about in this situation. We know it from contact with our own builders. We have worked with them in handling our products. We know what they face. We also know that our own selfish interests are best served by making it possible for them to make a healthy, liberal profit for themselves and to build up a permanent, prosperous business.

## Make an Easy Start with the Most Popular Custom-Built Receiver!

We believe the new SCOTT WORLD'S RECORD SHIELD GRID NINE is the most popular and powerful custom-built radio receiver ever placed on the market. Shortly after its introduction, we were swamped with orders for it. During the last four years we have brought out three different models and we are extremely proud of the fact that not one of these has been a "lemon." Every model has always been a receiver that would perform and a big success. Within the last three months we have been forced to more than double our laboratory floor space and to treble our staff of workers. Only within the past few weeks have we been able to catch up with and keep apace of the sensational demand for this new receiver. It has everything you can ask for, wonderful tone, hair-line selectivity, with tremendous volume. Herein lies an opportunity for the progressive professional set-builder. With such a receiver and such a sales policy as we have outlined, his success is assured. We are constantly adding to the Scott sales organization and we invite sincere, able, hardworking set-builders everywhere to join us in establishing for themselves lasting, secure businesses in this great field.

## How to Sell Custom-Built Radio

We will, within the next few days, have off the press a new sales manual entitled "How to Sell Good Custom-Built Radio." It contains the composite experience of hundreds of successful professional set-builders. It is a liberal education in the art of selling this wonderful product—custom-built radio. It will save many an hour and make many a dollar of profit for set-builders everywhere. A copy will be sent free to any professional set-builder and to anyone who contemplates getting into this field. Write, giving us an idea of your experience as a set-builder, stating the number of sets you have built and sold. Second, write us fully, telling just what you think of this idea of protecting the retail market for the professional set-builder and making such suggestions as you wish along the line of placing this business of custom-built radio on a firm foundation. Just fill out the coupon below and attach to your letter, and the book will be sent to you as soon as it is off the press.

E H Scott

**Mail This Coupon to Mr. Scott Today**

C B 11

**E. H. SCOTT**
**Scott Transformer Company**
**4448 Ravenswood Ave.**
**Chicago, Illinois**

Enclosed is my letter expressing my ideas about your plan of protecting the retail market for the Professional Radio Set-builders. I am a professional myself, as shown in my letter. Please send me a free copy of your sales manual, "How to Sell Good Custom-Built Radios."

Name....................

Address....................

City.................... State....................

licensing agreement set a $100,000 per annum minimum royalty payment. Large and medium size manufacturers could meet this minimum, because annual sales of only $1,333,333 was necessary at 7 1/2% to reach the minimum royalty level. At this time it appeared that RCA would not waste its time and money going after companies with sales of less than a million dollars per year.

One of the most significant aspects of the RCA patent agreements in this period was that the use of the superheterodyne patents was withheld from all of its licensees. So none of the licensed manufacturers could build superheterodyne receivers. The only way that superhets could be built was by the home constructor, the custom set builder or a small manufacturer whom RCA would not pursue. There were various reasons why the individual or custom builder would not be stopped by RCA even though they probably would have preferred to do so. First, when Armstrong sold his original superhet patent to Westinghouse, who later transferred it to RCA, he retained experimental and amateur rights. It was said that RCA did not think these fields would amount to much and only wanted to control the manufacturing of receivers using the superhet principles. Second, RCA was not about to pursue legal action against individual set builders, custom set builders, or even small manufacturers because the cost would not justify the results and the unpopularity of such actions would only make matters worse. RCA always maintained that it wished to encourage the radio amateur and constructor. Third, RCA was also in the radio parts business and could only benefit more from the sale of parts to the home constructor and custom builder than they could ever hope to gain by chasing after them for royalty payments on even a few hundred sets that leading custom set builders might construct annually.

From 1927 onward, for a few years Scott was to have no problems with RCA's patent actions. First, he was only a component manufacturer making primarily intermediate frequency transformers. For the various superhets which resulted from his work, he combined these parts with other components to form kits, which he sold to home constructors and custom set builders. When he built some sets in his own facilities he was still largely a custom builder. However, we shall see in Chapter 6 how he finally ran afoul of RCA's patents as his business grew in the 1930's.

Actually, RCA's patent policies in the 1920's worked very much to the advantage of the home and custom set builders. They could build superheterodyne receivers and use any patented circuits which they preferred without interference from RCA. Conversely, RCA's patent policies in that period proved to be a real detriment to the set manufacturers. They could not build superhets and even had to struggle to solve basic problems, which could have been solved rather easily if they could have built superhets. An example was the matter of single-dial tuning. During a period of about two years (1926-1928) the radio set manufacturers (other than RCA) devoted considerable developmental effort to various mechanical and electrical arrangements for tuning multiple circuits in tuned radio frequency receivers to achieve single dial tuning. The scope of this effort is indicated by the fact that more than 100 U.S. patents were issued to cover this work. Practically none of it would have been necessary if RCA had permitted its licensees to build superheterodyne receivers. Ads for Scott's first single dial superhet receiver, the Shield Grid AC 9, initially appeared in 1929. It required none of the above patents which had been so laboriously developed by a radio industry that had been denied the superheterodyne patents by RCA, who was collecting 7½ % royalty payments for every radio that industry was building.

## The Last Scott Receiver For The Custom Builders

The Scott AC10 (also referred to as the World's Record Shield Grid AC10) appeared to be an extension of the Shield Grid 9. However, it had a few unique features such as single dial tuning (although at least one Shield Grid 9 has been found with single dial tuning *). This feature was emphasized in sales literature for the AC10. It was the first Scott receiver with separate optional accessories, which included a short wave converter and a remote control box. These accessories were both built at Scott Labs. The converter plugged into the first detector tube socket of the AC10 (see page 47 and page 48). The remote control box plugged into a socket specifically provided for it. From the remote control box, eight stations could be selected and the volume could be regulated.

** from "The Technology of the E.H. Scott Laboratories" by Kent A. King, A.W.A. Review, Volume 11, 1998*

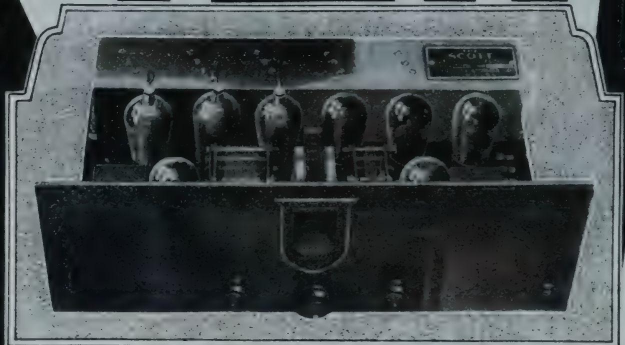
In the Shield Grid 9 the short wave antenna input bypassed the RF stage and fed directly into the first detector. In the AC10, the first RF stage was eliminated and an IF stage was added, bringing the total up to four. The screen grid tube was just being introduced at this time, so a variety of tubes were utilized. In the Shield Grid 9, a type 322 was used initially, followed by a type 222 in the Shield Grid 9B. A type 224 was used in the AC10. These tubes were used in the IF and RF circuits.

The remote control was unique in that it did not use motors. The oscillator circuit extended out to the remote control box. It apparently used the circuitry conceived by Chester Brush, whose patent is described in Appendix A.

The AC10 was introduced in the last half of 1929 and sales were unusually good considering it coincided with the beginning of the Great Depression. Sales rose to $384,980, up from $175,295 in 1928. Of course, the 1929 sales were contributed to by both the Shield Grid 9 and the AC10. In 1930, sales dropped back to $235,083.

By 1932, E.H. Scott had an RCA License in his pocket, so he decided to build superhetrodynes at his Laboratories rather than supply them to custom builders. The AC10 was to become the last set for them. It was followed by the ALLWAVE 12 supplied directly to the customer.

# THE NEW




# SCOTT A-C SCREEN GRID 10

## *Screen Grid Performance Plus!*

*Eighteen months* ago Scott announced a receiver using screen-grid tubes. This model was the result of nearly six months' work in the laboratory. The new 1930 Scott A-C Screen-Grid 10 is therefore the result of two years' actual experience with screen-grid receivers. The performance of this new model is so far in advance of any other receiver on the market today, that there is no standard with which to compare it. It uses ten tubes, three of which are screen-grid. The micro-matched Scott shielded intermediate transformers secure almost unbelievable amplification out of each screen-grid tube.

### *Unlimited Distance Range*

The tremendous power of the new Scott A-C Screen-Grid 10 gives distance reception undreamed of a year ago. Stations come in with more volume than is ever desired. Every station seems like a local. Proof of this is the verification of station 2ME of Sydney, Australia, on March 12th of this year *right from the center of Chicago.*

### *Keen Selectivity*

There is a different station on every point of the dial. By turning the single drum dial just a degree the most powerful local vanishes. Then, as you turn to the next point, some far off station perhaps a thousand, two thousand, or three thousand miles away thunders in. Another turn and it is gone. Never before has such perfect, sharp, yet easily handled selectivity been built into a receiver. Scott has outdone Scott! The possibilities of this new set actually dwarf the world's record established on the original Scott World's Record Receiver. Remember what it did—brought in 117 different programs from stations, the closest of which was 6,000 miles to as far away as 8,375 miles, during a 13 week test period. It has challenged the entire radio industry to equal its performance—and none have answered it.

### *Absolutely Humless*

The filter system used in this new Scott Custom-Built A-C Screen Grid 10 is so perfect that every trace of A. C. hum has been eliminated. Bend down, put your ear right up against the speaker, and you find it difficult to believe the receiver is switched on. The downright realism of the tone amazes you, when you hear it with every trace of A.C. hum eliminated.

**Custom Set Builders and Dealers**

If you are interested in selling the one receiver which has no competition, and at the same time enjoy an absolutely protected market, check the coupon and mail at once.

### *New Scott Short Wave Converter Tunes as Easily as a Broadcast Receiver*

Here is a new kind of short wave converter. Gone forever, is that tricky, critical tuning, formerly required to tune a short wave receiver. A new feature we have developed in the laboratory spreads the stations in each band to what amounts to a tuning dial *twenty inches in diameter.* It brings in voice and code alike with perfect clarity. Listen to stations in England, Germany, France, South Africa, Australia and New Zealand. You hear them all from 14 to 80 meters. Here is a real *international* receiver. Order a short wave converter when you order your Scott A-C Screen Grid 10—price $32.50.

### MAIL COUPON

The coupon from this announcement will bring you full particulars of the New Scott A-C Screen Grid 10—also pictures and descriptions of the many gorgeous console cabinets especially built for this receiver. Clip the coupon—mail it now—today!

SCOTT TRANSFORMER CO., *Clip Now!*
4450 Ravenswood Ave.,
Chicago, Ill.

CRCB10

☐ Send me full particulars of the New Scott A-C Shield Grid 10.

☐ Send me your franchised Set Builders Proposition.

NAME ____________

ADDRESS ____________

TOWN ____________ STATE ____________

**SCOTT TRANSFORMER CO., 4450 Ravenswood Ave., CHICAGO., ILL.**

(Citizen's Radio Call Book - November 1929 )

# Chapter 6
# Short Wave Reception

## Short Waves for a Polar Expedition

In his 1928 booklet, "How to Sell a Custom Built Radio," Scott wrote, "The regular short wave receiver consists of a regenerative detector, the output of which feeds straight into an audio amplifier." Since the first short wave receiver circuits appeared in the early 1920's, this had been the case. Although the very first radio experiments during the last quarter of the nineteenth century were conducted in the short wave range, Marconi's later work was in the long wave range. Then it was thought that to cover great distances with radio signals it was necessary to have large radiating systems, which resulted in long wave communication. During World War I, Trans-Atlantic stations were built to operate on wavelengths as high as 25,000 meters (12,000 cycles which would have been audible). In 1912, the US Department of Commerce assigned amateurs to wavelengths around 200 meters-just at the high end of the present AM broadcast band. Although limited by low power and the wavelength of 200 meters, amateurs communicated over ranges up to 2000 miles.

During 1924, while Scott was preparing for his trip to New Zealand, the MacMillan Arctic Expedition was using a 100 watt transmitter to communicate back to the USA on 150 meters (2000 kHz). On that polar trip they used only code transmission. MacMillan had with him a Zenith broadcast band receiver and succeeded in keeping in touch with the Zenith broadcast station WJAZ on the Edgewater Beach Hotel (This station was to become WEBH later). However, this reception had little to do with short waves. It was decided that in 1925 John L. Reinartz, an inveterate amateur experimenter, would accompany the expedition to conduct short wave experiments in the polar region for ruggedness and stability of equipment but mainly for putting a strong short wave signal into the United States.

It was also decided that Commander E.F. McDonald, President of Zenith Radio Corporation and at that time President of the National Association of Broadcasters, was to accompany MacMillan on his Expedition that year. The voyage was to be in the Arctic region during June, July and August of 1925. At a meeting held toward the end of April, 1925, in the Laboratories of the Zenith Radio Corporation, Chicago, Illinois, radio scientists met with Reinartz and Commander MacMillan to determine the type of short wave transmitting and receiving equipment with which the Expedition was to be equipped. It was definitely decided that MacMillan would be equipped with transmitters and receivers capable of four wavelength ranges-20, 40, 80 and 180 meters. The geographic section to which the Expedition was to go this year was considered to be one of the most difficult from the standpoint of radio transmission and reception-namely, between 50 degrees and 75 degrees North latitude in Davis Straits. The 20 meter equipment was to be used during the period just before and after noon. The Expedition would be in twenty four hours of daylight after passing latitude 60 degrees North. The 40 meter equipment was to be used during the hours surrounding midnight, when it would be daylight in the Arctic but dark in the lower degrees of latitude. The 80 meter equipment was provided as an emergency compromise to cope with unanticipated conditions. The 180 meter equipment was provided only for the purpose of demonstrating that communication in this band was not possible over great distance under the existing conditions.

One of the startling facts brought out during the meetings at Zenith was that there were fewer than twenty amateurs in the United States who had done constructive work at 20 meters by 1925. It was urged that US amateurs expand their activity at these wavelengths to maintain the lead they had enjoyed in the nations of the world in radio in the past. So far as was known none of the amateurs of foreign countries, except Leon DeLoy of France, had done any material work at low wavelengths and his work, so far as known, had reached only to 40 meters. It was pointed out at the conference that there was no standard transmitting or receiving apparatus capable of working on 20 meter

wavelengths for sale. It was necessary for American amateurs to build their own apparatus, which could be done at a relatively low cost. Reinartz used a simple regenerative single tube receiver for his short wave experimental work. Beverly Dudley, writing in the Chicago Evening Post in 1925, described short wave receivers of that day as simple, usually regenerative (over 50 percent of them were), not ordinarily employing R.F. amplification and made with smaller inductances and capacities than other sets.

In the 1925 MacMillan Expedition, provision was made for phone communications as well as code. It was intended that the phone transmissions would permit experimental work on modulation on the short wave bands. However, Commander Eugene McDonald of Zenith suggested that the songs of Eskimos be broadcast back to the USA for retransmission. Another short wave experimenter, Fred Schnell, the traffic manager of the American Radio Relay League, left on another expedition on active duty with the US Navy for maneuvers in the Pacific to participate in experiments to be conducted by the Navy during the same period that MacMillan and McDonald were to operate in the Arctic. He was to be on duty from mid-April until about October 1, 1925.

By 1926 a number of broadcast stations were experimenting with short wave operation and A.H. Grebe and Company of Richmond Hill, New York, one of the pioneer receiver manufacturers, placed on the market what it called a standard short wave receiver. The receiver spanned the tuning range of 30 MHz to 1500 kHz (10 to 200 meters) with five plug-in tuning coils. Only two tubes (a regenerative detector and an audio stage) were employed. By throwing the regenerative detector into oscillation a beat frequency could be provided for more precise tuning. The fact that such a simple receiver gave creditable results in the reception of distant stations indicated that short wave DXing was relatively easy compared to long distance DXing in the AM broadcast band (200 to 500 meters). This type of receiver with a stage added at either end in some cases survived among manufacturers until finally RCA decided to license its superheterodyne patents in 1930. A.H. Grebe became an RCA licensee in 1927, but was not licensed to make superhet receivers until 1930. As indicated above, it was not uncommon to expand on these simple receiver designs by adding an R.F. stage ahead of the regenerative detector and following it with two audio stages. Such an arrangement was considered to be a basic design just before the superhet patents were made available to the RCA licensees. However, one short wave set builder added two R.F. stages ahead of the regenerative detector to press the limits of stability.

## Scott Short Wave Receivers

The fantastic performance of simple short wave receivers gave Scott much food for thought. By 1928 at least 25 high-powered short wave broadcast stations were in operation around the world. It was also reported that set builders and radio fans were responding to constructional articles on short wave receivers by a ratio of three to one over such articles dealing with regular broadcast sets. Despite such reports, most of the major set manufacturers refused to believe that the public really wanted to listen to short wave stations. They contended that the day of DX listening to realize long distance reception records was a thing of the past. However, the phenomenal skip effects on short waves made it possible for the average listener to realize the feats performed by E.H. Scott and some of his contemporaries in the broadcast band a few years earlier. With even a relatively simple short wave receiver the average listener could regularly tune in stations in distant lands at certain hours of the day and night. He could feel on a daily basis the thrill of DX reception which had been reserved earlier for ardent experimenters like Scott. An example, as reported in Radio News of September, 1928, was the reception on a three tube receiver in South Wales, Australia. It was reported to have received the signal of the short wave transmitter of New York City's WRNY with such volume that it had to be turned down to keep from awakening the family. WRNY's power was only 500 watts.

Since Scott, an ardent DX fan, had based much of his approach to the radio business on the DX records which he established in the broadcast band during 1925, he had to meet the challenge and do his best in short wave receiver design and construction. He attacked the problem from all of the directions he could conceive. One approach was to equip the Shield Grid Nine Superhet with plug-in coils, which would allow it to tune to the short wave signals and receive them through the intermediate frequency amplifier just like the regular longer wave broadcast band signals. By this method, reception down to 30 meters or 10 MHz was possible. Later the range was extended down to 20 meters or 15 MHz. Such performance enabled Scott to lay claim to

# Scott Designs Short Wave Converter for His A. C.—D. C. Supers

*Unit Plugged Into First Detector Makes Short Wave Super Out of His Screen Grid Models*

BRINGING the Scott line of screen grid superheterodynes, both d. c. and a. c., up to a fuller measure of service, it has just been announced that Scott Transformer Co. is marketing a short wave converter by means of which either the Scott screen grid a. c. 10 or the Scott shield grid 9 broadcast receivers may be converted into short wave superheterodynes, with eight tubes in the case of the shield grid 9 or nine tubes in the case of the a. c. 10. There are two types of the converter, one of the a. c. type for the a. c. 10 super and the d. c. type for the shield grid 9.

*Fig. 1. This is the first model of the Scott short wave converter described for the first time in the accompanying article*

### Using Tank Condenser

By referring to the schematic wiring diagram shown in Fig. 3, one will observe there are several departures from conventional short wave converter practice. One feature is the fact that a tank condenser .000135 mfd is tuned by means of the small knob on the right-hand side of the converter shown in Fig. 1 and marked "minimum—1—2—3—maximum." The second condenser is a .00007 mfd and is on the dial of the converter. This is the condenser with which the actual tuning is performed. The capacities of these two condensers added together are equal to the capacity of a single condenser that would normally be used to cover the band in a regular short wave receiver or converter. By this method it is clear to see that he has a tuning dial exactly four times as large in effect as the tuning dial on the regular short wave converter or short wave receiver. With the system of tuning condensers employed in the Scott design, it is possible to cover the short wave spectrum with three coils. By the arrangement of a tank condenser having five tuning positions, it is possible to tune in a broadcast signal on short waves with greater facility than would ordinarily be encountered since the tuning is done with the very small capacity.

### In Shielded Can

All of the condensers and the detector tube are completely enclosed and shielded in a very solid burnished copper can. This assists materially in stabilizing the action of the converter and eliminates body capacity without effecting the efficiency of the converter.

### Chart Furnished

A calibration chart is furnished with the coils and it will be noted that there are three tuning curves, each of these curves plugging into four sections. For example: Supposing one wished to tune in a station on 28 meters. Coil No. 2 would be plugged in which covers a range between 23 and 40 meters. By setting the tank condenser at "minimum" and setting the main tuning dial somewhere between 50 and 70 degrees, 28 meters should be found. If it is desired to tune in a station on 64 meters, coil No. 3 may be plugged in which covers from 36 to 76 meters. The tank condenser should be set at "1" and be-

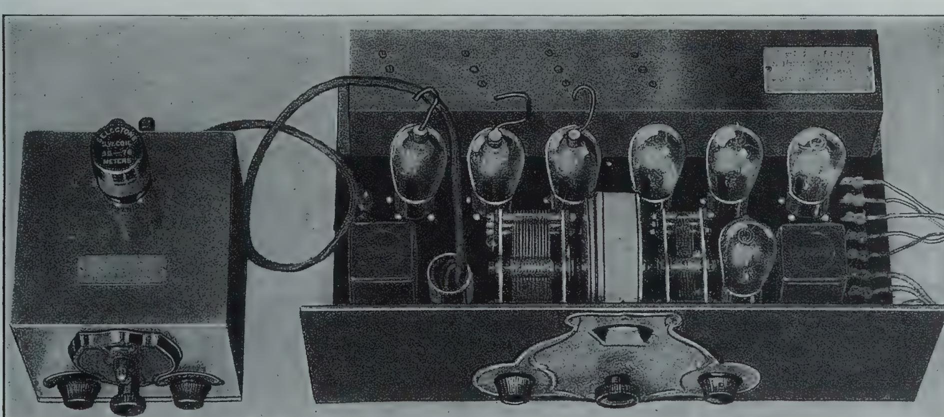


*Fig. 2. In this photograph is shown the Scott screen grid a. c. 10 with the converter shown at the left plugged into the first detector socket. Be sure to remove the oscillator tube at the right of the right-hand condenser after plugging in the adapter into the first detector. In the photograph the oscillator tube was left in its socket so that readers could observe the oscillator tube position since if the tube were pulled out the socket coul dnot be seen*

tween 80 and 100 on the tuning condenser, the 64 meter station should be found.

In the use of a tuning chart, if one knows the wavelength on which a station is operated, all that is necessary to do is to follow the horizontal line, opposite the wavelength, until you cross the tuning curve. This curve will show the operator the coil to use, whether to set the tank condenser at minimum, 1, 2 or maximum and by running down the vertical line to the bottom of the sheet you may ascertain approximately the degree number on the main tuning dial where the station should be found.

### Operating Instructions

Instructions for the operation of the converter in connection with the two Scott models are as follows: First remove the oscillator tube from the receiver. This is the tube nearest the panel on the right-hand side shown in Fig. 2. In the photograph the oscillator tube at the right of the right-hand condenser was left in on purpose so that the location of the oscillator might be ascertained. If the oscillator tube is not taken out it is likely that no station would be received. Next lay the oscillator tube aside and take out the first detector tube shown at the left of the first condenser. Take off the bottom of the converter and insert this tube in the socket inside of the converter, replacing the bottom of the can. In the s. g. 9 the first detector is the tube on the left-hand side inside the large copper can.

After removing the detector tube and placing it in the converter, plug the cable plug connected to the converter into the socket on the receiver from which the detector tube was removed. Disconnect the antenna and ground from the receiver and connect to antenna and ground posts on the converter. Now select the coil covering the wave band you wish to tune in and plug the coil into the socket on top of

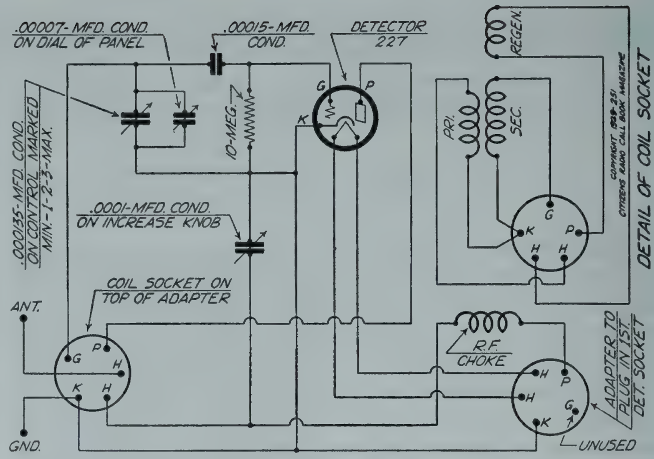



*Fig. 3. The schematic diagram of the converter is shown in this illustration. The upper right-hand portion is a detail drawing of the coil socket located on top of the can*

the converter. Switch on the receiver and you are ready to tune in.

It will be noticed that the regular tuning dials on the receiver have no effect on the tuning or operation of the short wave converter. The only knob used in the receiver is the volume control which is the small knob on the right-hand side of the panel, Fig. 2.

### Making Set Oscillate

For code reception the volume control on the set is turned on until the operator hears a rushing noise which puts the tubes into oscillation. When it is desired to receive telephony or music, the volume control must be turned down until the receiver is just below this point of oscillation, as music or voice cannot be received satisfactorily when the receiver is oscillating. According to the designers, on the two larger coils it is possible to use an antenna up to 600 feet in length, with good pick-up and sensitivity. However, with this much input on the small coil (14 to 26 meters) it is likely to knock the tube out of oscillation and, therefore, it is necessary to use one of not more than 80 feet in length when tuning between 14 and 20 meters. Under ordinary circumstances the regular broadcast antenna will serve in a very satisfactory manner. It may be necessary to use a ground, although in most cases the converter will function equally as well without. This, however, is best determined by experimentation. In instructions issued with the converter, the designer states that the Arcturus type 127 tube should be used in the converter position since it works entirely satisfactorily on the higher frequencies.

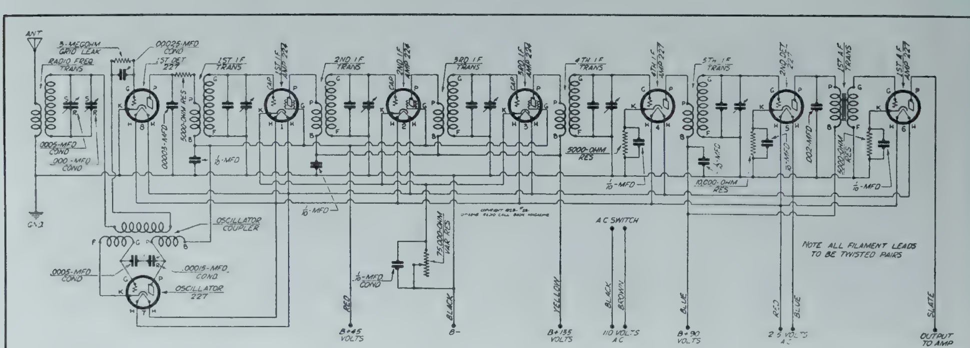



*Fig. 4. For those interested in seeing how the converter operates, we are showing a complete schematic of the screen grid a. c. 10 into the first detector of which the converter should be plugged, thus giving intermediate amplification at short waves as well as audio amplification*

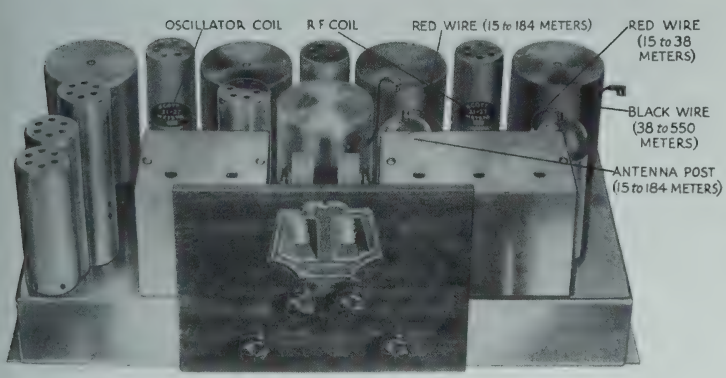
having offered the first allwave receiver to the general public in 1928.

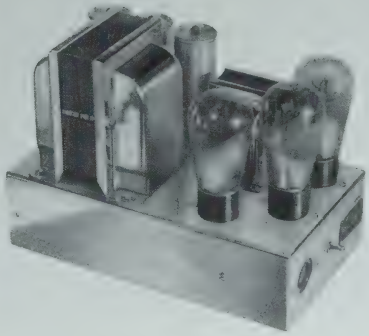
A second approach was to use a converter to make possible the tuning and heterodyning of short wave signals to feed through a superheterodyne's i.f. amplifier. He tackled this approach by building a converter which could be plugged into the mixer tube socket of a superhet-such as those in his Shield Grid Series. In front of the mixer socket it tuned in the short wave signals and used a substitute autodyne first detector to generate a signal at the intermediate frequency. Here again the superheterodyne principle was applied to short wave reception.

Third, leaving no stone unturned, Scott introduced a four tube t.r.f. set expanding on the Grebe set mentioned above with an r.f. stage and an additional audio stage. This receiver, called the Scott Symphony, was the only non-superhet set that Scott ever built after launching his radio business career in 1925. It was available both in D.C. (battery-operated) and A.C. (powerline operated) versions. The A.C. version used one screen grid tube, but the D.C. version used triodes throughout. Offered during 1929, these two models were sold for only about one year. In 1930, Scott reverted to superheterodynes only and never deviated again during the remainder of his career.

Introducing his ALLWAVE 12 (two dial tuning with plug-in coils) in 1930, Scott was saturated with testimonials of foreign reception within a short time. Set owners across the US were reporting reception from London, Rome, Ecuador, Austria, and other countries. By December, 1931, Scott reported that he had enjoyed every broadcast from VK3ME, Melbourne Australia, for a 16 week period. He stated that the ALLWAVE 12 receivers which he was delivering to his customers would differ in no way from the set which provided the above reception results. They would be identical to the hundreds of other Scott ALLWAVE receivers that tuned in England, France, Germany, Italy, Japan, Indo-China and South America every day in the week.

During the first half of 1932, Scott ran one and two page ads monthly in Radio News to cover the performance of his ALLWAVE 12 receiver. Not only did he report many testimonials of his customers, but reported as well that Scott ALLWAVE receivers were in use in 63 countries around the world. He reported 815 logs of foreign reception from Scott owners in January, 1932. His advertising of short wave reception by the ALLWAVE 12 receiver reached a climax in June, 1932, with 4 full pages of advertising in Radio News. Here he showed logs of an owner in Pennsylvania, who detailed programs from VK2ME of Australia, and logs from an owner in Massachusetts who detailed programs from France, England, Italy, and Columbia. He also showed an audited report of 9,535 logs of programs reported by purchasers of the Scott ALLWAVE receivers from 186 stations, foreign to the country in which they were received, for the first three months of 1932.



**ALLWAVE 12 (Two Dial w/Plug-In Coils) Chassis and Mating Power Supply/Amplifier**

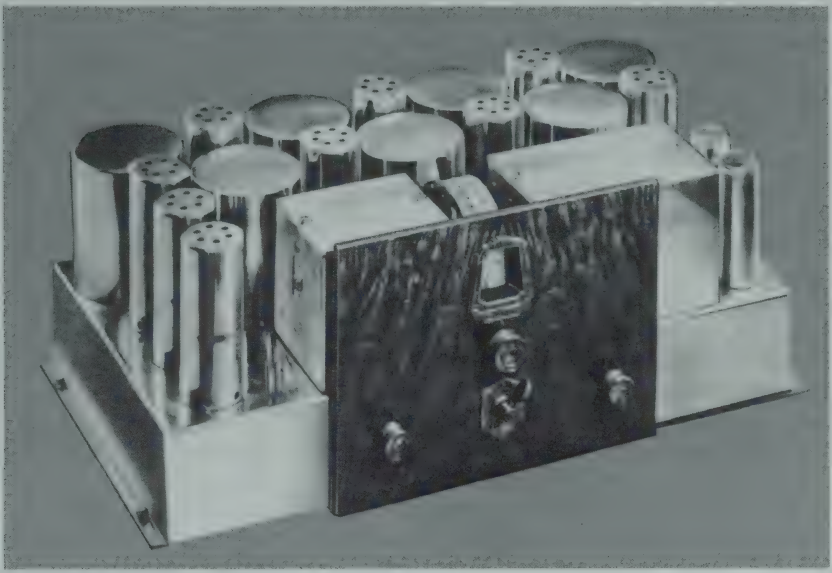
Although the ALLWAVE 12 provided excellent reception results, a number of problems relating to short wave receiver design remained to be solved. These involved the elimination of plug-in coils, the provision of more precise tuning by a single knob and antenna improvements. From his start in the radio business, Scott had depended upon two technicians, Clifford Coon and Arthur Finney, for technical assistance and the construction of his kit sets. Although the receivers, which were developed under Scott's guidance with their help, had excellent performance records, they had not been characterized by patentable developments. By 1932 Scott had hired Ernest R. Pfaff as his Chief Engineer. Pfaff had started his engineering career with Western Electric in the early 1920's, later joined Temple Radio and had been with Silver-Marshall a few years prior to joining Scott. Pfaff had ideas about eliminating plug-in coils and improving the tuning of short wave signals. These ideas were incorporated in the Scott ALLWAVE 12 DELUXE receiver, a 12 tube model not using plug-in coils and tuning all stations with a single dial, which was introduced in mid-1932. Later that year, Pfaff filed a patent application for the coil changing device, which eliminated the need for plug-in coils. After the usual delay in the Patent Office, Pfaff was granted US patent # 1,986,525. A little later, Pfaff filed a patent application for the entire receiving system and was eventually granted patent # 2,035,668 for this invention. There was need for a tuning control which was positive in action with no lost motion between the various elements. George Roethel, Jr., Scott's mechanical engineer, designed such a tuning control and also applied for a patent later in 1932. It was granted about six months after that of Pfaff's coil changing device. Before the end of 1932, Pfaff also filed a patent application for a tuning dial which was combined with a tuning indicator, which cast a shadow upon the dial scale in such a way that the tuning meter indication and the dial reading could be seen in the same area thereby eliminating the need to look separately at the dial reading and the tuning indication.* A patent for this application was also granted later than the others mentioned above.

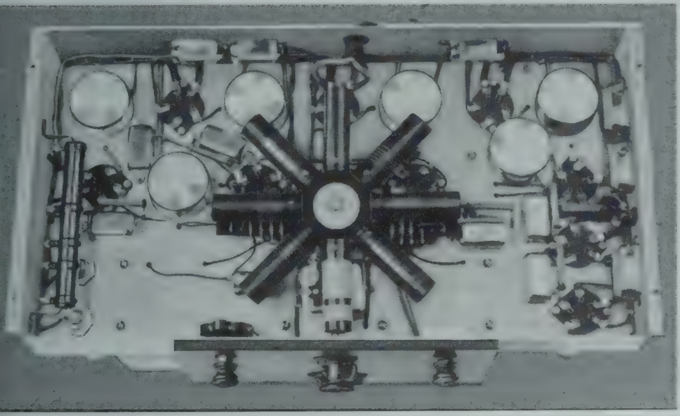
Although Scott had devoted much of his time in 1931 and 1932 to establishing records in short wave reception, he reverted to AM broadcast band DXing on a trip to New Zealand and Australia during the first half of 1933. On February 15, 1933, he sailed on a reception test cruise from San Francisco on the ocean liner R.M.S. Maunganui bound for those countries south of the Equator. Scott reported that every night until he arrived in Wellington, New Zealand on March 5, he logged the entire "Round the Town" program transmitted from WBBM (operating at 780 kHz) in Chicago. On the return journey on board the S.S. Mariposa he repeated the feat. Every night he made a report to WBBM by radiogram of his reception of each program. Scott made his first reception test on the night that he left San Francisco and added about 400 miles a day as the ship moved toward New Zealand. When he arrived there he was still receiving WBBM. Night after night Scott furnished dance music direct from Chicago for the passengers on both ships to the amazement of the radio engineers, who sat with him to check the reception throughout the trips. Later Scott wrote that this test was made to prove that the Scott ALLWAVE 12 DELUXE receiver had enough reserve power to bring in stations from one side of the world to the other on the broadcast band, as it had already proved it could do on the short wave bands. It was apparent that despite the phenomenal results which he had attained on the short wave bands during 1931 and 1932, Scott realized that they represented nowhere near the feats of broadcast band reception which he had achieved during the 1920's. It is not to take anything away from the performance of the Scott ALLWAVE receivers from 1930 onward to simply state that short wave reception was comparatively easy and through the years has become continually more so-witness today's solid state portables which receive many distant stations with a simple vertical antenna, which is pulled right out of the cabinet. However, that is not to say that one cannot receive more stations with less noise and interference with better receivers and better antennas.

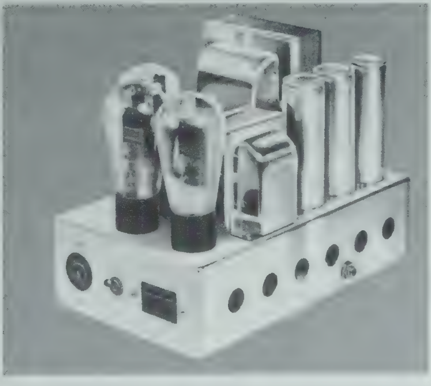
## Further Development

During the eighteen months following the introduction of the Scott ALLWAVE 12 DELUXE receiver, various ways were found to improve its performance. One such improvement involved the receiving antenna system. From 1928, Scott had worked to develop an antenna system that would give the greatest possible efficiency in the reception of broadcast and short wave stations and at the same time, if possible, reduce the effects of

* *A 13-tube version of the Allwave Deluxe included this feature*







**ALLWAVE 12 Deluxe Receiver Chassis(Top)**
**Under Chassis View Showing Coil Changing Mechanism (Center Left)**
**Mating Power Supply/Audio Amplifier (Bottom Right)**

interference and noise. In 1930 Scott introduced an Allwave antenna comprised of a modified transposed double doublet which increased signal pickup, and, at the same time, reduced the noise picked up on the antenna lead-in. Development was leading to an external shielded coupler to provide further noise reduction and increased antenna efficiency. It was also found that the performance of the Scott ALLWAVE 12 DELUXE receiver could be improved by tuning the antenna, so an auxiliary antenna tuner was supplied.

By 1933, the new 2A3 triode tubes providing greater power output and less distortion became available, and a circuit that tuned the antenna automatically and eliminated the need for an external antenna tuner was developed. At about the same time, a visual tuning system which enabled one to tune in the stations in all bands with greater ease and accuracy was perfected. Also, an improved method of locating short wave stations on the dial in conjunction with a beat frequency oscillator was available. It was impossible to incorporate all of these developments in the ALLWAVE 12 DELUXE receiver. An additional tube was needed to operate the tuning indicator, more space was required on the chassis for the extra coils used in connection with the automatic tuning of the antenna, and heavier power transformers were needed to supply the increased current required to drive the new 2A3 triodes. The only solution was to design a completely new receiver, the Scott ALLWAVE FIFTEEN, with all of the new developments engineered into it. Other new features included an improved method of coupling and shielding in the i.f. amplifier permitting considerably higher gain with stability. This receiver was introduced early in 1934 and about the same time it was possible to provide the Scott Super-Shield Antenna System with the shielded external coupler mentioned above.

Although I had not yet joined Scott Radio Laboratories, I was working in Chicago during the summer of 1934 and had an opportunity to visit the World's Fair or Century of Progress as it was called. There, along Chicago's lakefront, I saw for the first time Scott receivers being built and tested. Scott had an exhibit which he called a "miniature" of his laboratory in the Electrical and Radio building at the Fair. Also, he had installed in the Control Room at the top of the Sky Ride an ALLWAVE receiver near the motors, contacts and other electrical equipment which operated and controlled the Sky Ride. Needless to say, the environment was loaded with electrical noise. As I recall a musical program was being received by the Scott set without any apparent interference. It must have been a convincing demonstration for the public.

Despite their earlier lack of enthusiasm for short wave reception, the leading radio receiver manufacturers had found that a phenomenal increase in radio sales could be attributed to the greater demand for foreign reception. This demand made every owner of a regular broadcast band receiver a prospect for a short wave receiver or a combination that would receive short waves as well as the broadcast band. After RCA made the superheterodyne available to its licensees, manufacturers succeeded in providing for short wave reception along with standard broadcast reception at only slight additional cost. The result was that in 1934 eighty to ninety percent of the radios being sold were of this type. In nationally advertised sets, the best selling models were consoles with foreign bands accounting for 60% to 85% of the total sales in that category. In the popular priced models, the short wave combinations made up 75% to 95% of the total. Most of these sets worked sufficiently well to satisfy their users. At the top of the line in manufactured sets, Zenith brought out its Stratosphere model selling at $750 around the end of 1934. This receiver covered the frequency range of 535 kHz to 63.6 MHz in five bands and although it was obviously designed for optimum short wave reception, it also had many of the features of a high fidelity receiver. It was obvious that either a custom-made high quality short wave receiver or high quality manufactured one would provide better short wave performance than any of the lesser manufactured ones. However, it was apparent that the performance of the lesser ones was sufficiently good that custom builders like Scott could no longer depend upon short waves alone to make a market.

Scott's ALLWAVE FIFTEEN had many of the features of a high fidelity receiver, such as excellent low distortion audio and a wide tonal range for an AM set. Its basic power amplifier and power supply contained two 2A3 triodes in push-pull and a single 5Z3 rectifier. Sometimes its tuner was combined with a larger power amplifier and power supply, which contained four 2A3 tubes in push-pull parallel and two 5Z3 rectifiers. In this case another tube was added in the audio driver section bringing the total up to nineteen tubes. Thus, in effect an ALLWAVE NINETEEN was created. In March, 1935 Scott had ready a new 23 tube receiver. At first he called it the IMPERIAL ALLWAVE, but as the emphasis shifted

to high fidelity, he advertised it as the High Fidelity Allwave receiver in the May, 1935 issue of Radio News. Finally as he placed high fidelity above DX reception as the focus of major emphasis in October, 1935, he introduced the set as the Scott FULL RANGE HIGH FIDELITY receiver. The subject of high fidelity and Scott's role in it are covered in more detail in Chapter 8.

It should be mentioned here that RCA finally caught up with Scott on the patent licensing situation and sued him in 1932. This action was taken about the time that the US government settled its consent decree with RCA toward the end of 1932. This decree allowed RCA to continue to license its patents and they decided to force everyone regardless of size to conform. The only way that a company could avoid such licensing was to sue RCA for restraint of trade as Zenith did as a counter to the suit which RCA filed against them. Zenith could afford to pursue the matter legally. They persisted and eventually won, but Scott did not have the resources to pursue a legal battle, so he settled out of court and became an RCA licensee. He could get much better terms with RCA in 1933 than he could have gotten during the 1920's. It was no longer necessary to pay the $100,000 minimum or to pay 7½%, in royalties. Royalty percentages were coming down to 2¼% and it was no longer mandatory to use RCA tubes. By settling with RCA, Scott finally gained access to every patent for radio receivers for broadcast and entertainment purposes owned by RCA, GE, AT&T and Westinghouse. To complete the picture, Scott also took a license with the Hazeltine Laboratories.

•The *Custom-built* SCOTT ALL·WAVE 15

# DEVELOPED

# NEW

## to a point far beyond the attainments of "new models"

### Console Designs and Chassis Refinements

● 15 tube superheterodyne circuit with Pre-Selector stage using a triple grid super control type 58 tube. ● 13 to 550 meter wave bands completely covered by means of exclusive, simple mechanical coil changing device. ● Accurate dial calibration on *all* wave bands for the first time in all-wave radio history. ● Short wave Station Locator, employing button-controlled Beat Frequency Oscillator. ● Silent, Visual Tuning and *true* Single Dial control, without trimmers or auxiliary dials even for Antenna Tuning, which is automatically accomplished when changing wave bands. ● Perfected Automatic Volume Control, plus Manual Volume Control to free the mighty volume of *true*, full 11 watt output without a trace of distortion. ● Efficient Static Control. Most perfect Tonal Quality known in radio. Sensitivity and Selectivity never before known. All parts protected to withstand climatic changes. ● Five-year guarantee of all parts (except tubes).

For years the performance of SCOTT receivers has *merely begun* at the highest point of efficiency reached by most radio receivers. And so, what more natural than that recent refinements made in SCOTT design should keep this mighty receiver still years ahead of competitive all-wave receivers?

The SCOTT guarantee tells the whole story. It says, briefly and positively, "The SCOTT ALL-WAVE FIFTEEN is guaranteed to out-perform any other receiver in either a Laboratory or a side-by-side reception test." That leaves *you* to be the sole judge—and a ten-year reputation for honest, fair dealing assures acceptance of your opinion without quibbling.

SCOTT dares to make such a sweeping guarantee because this receiver is custom built, in one of the world's finest radio Laboratories, by technicians of highest skill. Greatest precision installs the highest quality parts. The most careful adjustments and tests with Laboratory Precision Measuring Instruments attend every step of its construction. It is accurately calibrated on all wave bands. And every claim made for it is backed by 100% PROOF!

Get complete information regarding this receiver that makes the phrase "The World's Finest Receiver" more than ever a statement of fact instead of a vain boast.

**E. H. SCOTT RADIO LABORATORIES, INC.**
**4450 Ravenswood Ave., Dept. N-44, Chicago, Illinois**

*Above is shown the Waverley Console, one of several new cabinets created by SCOTT designers to house this mighty receiver in proper fashion.*

## SEND COUPON FOR DETAILS

E. H. SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Ave., Dept. N-44, Chicago, Ill.

Send me particulars regarding the SCOTT ALL-WAVE FIFTEEN, and PROOF of its vast superiority.

*Name* ..................................................

*Address* ..................................................

*Town* .................................... *State* ....................

**ALLWAVE 15 Advertisement**
(Radio News - April, 1934)

# Chapter 7
# Scott's Competitors

Scott had competition throughout his radio business career. It was just more severe during certain periods than others. When he was building intermediate frequency transformers during 1927 to 1930, there were certainly many other companies making such components and claiming that theirs were also matched units. The prime factor that minimized competition until 1930 was the fact that RCA would not permit any of its licensees to manufacture superheterodynes. As a kit and component supplier, Scott did not have to contend with licensed manufacturers other than RCA. However, there were several other purveyors of superheterodyne kits.

## Lincoln Radio Corporation

While McMurdo Silver, through Silver-Marshall, Inc., offered kits which paralleled and sometimes upstaged Scott's circuits from 1925 to 1930, Silver's top priority during that period was to become a large manufacturer. In that role, he could not manufacture superhets because of the limitations in the RCA license held by Silver-Marshall, Inc. A more direct competitor, starting in 1928, was the Lincoln Radio Corporation. It was the company of William H. Hollister, who during the autumn of 1927 wrote a testimonial to Scott praising the "World's Record Super 10." In it he stated "I can tune in station KFI every evening after 9:30 p.m., having no interference from local stations and with volume equal to local stations." During 1928 the Lincoln Radio Corporation, located at 329 South Wood Street in Chicago, advertised itself as a national distributor for several brands of kits-such as, Silver-Marshall, Sargent-Rayment, Tyrman, HFL, and Scott. Assembled and tested kits of these brands were offered, and demonstrations of the various kits could be provided.

Later in 1928, Hollister decided to sell his own superheterodyne kit as well as the others, and in November of that year introduced his Lincoln 8-80 Super. In a full page advertisement featuring the Lincoln receiver he also offered as Lincoln-Guaranteed complete kits: The Silver-Marshall Model 720 Screen Grid Six both as a kit and factory-wired, the 1929 S-M Laboratory Superheterodyne, Tyrman kits and Scott's World Record 9-tube Shield Grid Superhet. The Lincoln 8-80 was strictly a broadcast band receiver with a more modernized approach to its intermediate frequency stages. The idea of matching the i.f. transformers at the factory or in the laboratory prior to packaging them into a receiver kit was abandoned. Means were provided for tuning each i.f. stage after the receiver was assembled. Small variable condensers near the top of each transformer tuned the plate windings in four stages. Knobs were even attached to these condensers to facilitate the alignment procedure. It was possible to tune the i.f. stages at any frequency from 350 to 550 kilohertz. Although this method of tuning the i.f. transformers was far better than matching them at the factory to some fractional turn of the windings, it is hard to see what was gained by being able to tune them through such a wide frequency range. The 8-80 Super provided a sort of a laboratory for investigating the results to be realized by a variety of intermediate frequencies. Of course, by choosing certain i.f. tuning, it was possible to shift image signals and move them away from interfering points.

In any event, several advantages were realized with this receiver. The i.f. stages did not require the high order of shielding found in both Silver-Marshall and Scott screen grid receivers. Shielding the transformer can for each stage was sufficient. Over most of the broadcast band, due to the comparatively high intermediate frequency, stations were tuned in at only one point on the dial, which led to the set being called a "One-Spot" superhet. It used a screen grid first detector as well as three screen grid tubes in the i.f. stages. The second detector and the first audio stage employed 201 A tubes and the audio output stage contained a 171A tube. This receiver was a D.C. or a battery-operated type, and could be used with A.C. power only when the proper external converters were employed.

In March 1930, Hollister introduced a new receiver-the Lincoln Deluxe 10. This receiver, using the same general i.f. design as the 8-80 superhet, utilized AC cathode tubes and a separate type 80 rectifier in a B power supply. The number of tubes was increased from eight to ten with an additional screen grid i.f. stage and two type 45 triodes in a push-pull audio output stage instead of the single 171A. The type 80 rectifier was not counted in the ten. This receiver was said to have exceptional selectivity as evidenced by clean separation of weaker distant stations from strong local stations operating on adjacent channels. Despite this high degree of selectivity, tone quality was still adequate to provide satisfactory reception. As local broadcast transmitters in the large cities increased their power, the ability of a receiver to pick up the weak signals of distant stations became more and more important to the DX fan. This receiver had single dial tuning, but not much was made of this feature in the Lincoln advertising. Since this receiver did not incorporate a tuned r.f. stage, there were only two tuned circuits in its front end-the input circuit to the first detector and the oscillator.

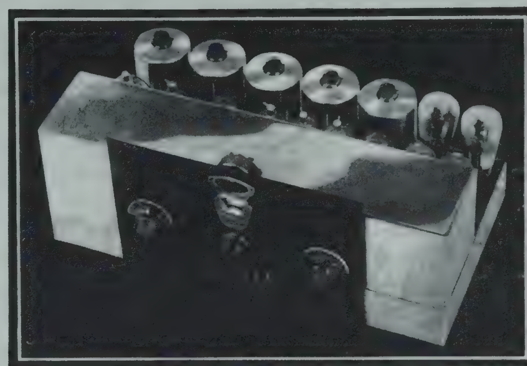
In November 1930, Hollister introduced essentially the same receiver as the model Deluxe-31. Scott was already putting emphasis on short wave reception with his ALLWAVE 12. It had two dial tuning and plug-in coils, but it offered considerably more than the Lincoln Deluxe-31 with its short wave capability. Undoubtedly to compete, Hollister introduced the Lincoln SW-31 with short wave capability in May of 1931. Because of the lack of an r.f. stage ahead of the first detector, it was possible to use only a single plug-in coil for each band. At this point, Hollister did not have single dial tuning any more than Scott did, so he tuned the first detector input circuit in the short wave hands with the condenser which was tuned from the front panel as an antenna trimmer in the broadcast band. Thus, in effect he covered each band with two tuning controls and a change of one plug-in coil per band. Five bands were covered as follows: 15-32 meters, 25.5-47 meters, 46.5-84 meters, 81-231 meters and 190-540 meters.

Starting in 1931, Hollister labeled his new models with the letters SW followed by the last two numbers of the year in which they were to sell. So the SW-31 was followed by the SW-32. The latter was introduced in January 1932, with switched coils for all bands and two section ganged tuning condensers. The center control knob on the front panel of this receiver operated the ganged condenser. The knob to its right operated an on-off power switch and the volume control. A knob at the immediate left operated a trimmer condenser to compensate for what was not quite single dial tuning. An ornamental knob at the extreme left controlled the five position band switch. A knob at the extreme right controlled a hi-lo switch, which shunted a resistor across the primary of the 1st i.f. transformer to prevent overloading when strong signals were received. Automatic volume control was not incorporated, so some means had to be provided to prevent overloading due to strong local signals. Competitively, this SW-32 receiver upstaged Scott by about six months. The ALLWAVE 12 DELUXE with single dial tuning and switched coils was not introduced until the mid-summer of 1932. However, the Scott ALLWAVE 12 DELUXE had true single dial tuning with no trimmers to be adjusted from the front panel. The band-changing knob was underneath the single tuning knob with the volume control on one side and a tone control on the other side of the front panel. To eliminate A.C. hum pickup that might result from a combination of the volume control and the on-off switch, the latter was located at the end of an extension cord and mounted on the side of the cabinet. In addition, the Scott ALLWAVE 12 DELUXE had automatic volume control, the voltage for which was derived from the Wunderlich tube which also functioned as the second detector. In the Lincoln SW-32 the screen grid second detector did not provide the d.c. voltage necessary for the automatic volume control.

Toward the end of 1932 Hollister introduced the Lincoln SW-33 model. Some of its features were silent tuning, a tuning indicator directly above the tuning dial, undistorted and high fidelity audio due to what was called three push-pull stages. The first such stage was described as the final i.f. amplifier feeding into the two input grids of a Wunderlich tube. The output of this detector fed into a triode push-pull first audio stage and this stage in turn fed into a triode push-pull output stage. In addition there was automatic volume control made possible by a d.c. voltage derived from the Wunderlich second detector tube. Except for changes in tube types and the inclusion of a tuning meter, the remainder of the SW-33 receiver was similar to the SW-32 model.

In April of 1933, Hollister introduced a receiver equipped with only short wave bands. Designated the R-9, it tuned from 8.8 to 216 meters in five bands. Coverage down to 8.8 meters was provided to include

# Tune the NEW way *for* World-Wide Reception *with the* LINCOLN DE·LUXE·SW·33



## SILENT TUNING...

The weakest carrier wave is registered on the signal indicator and can be tuned with precision and perfect silence without disturbing atmospheric noises.

## SIGNAL INDICATOR

A meter directly above the dial indicates, not only the weakest signal, but allows the operator to tune into a signal perfectly. Guess work is entirely eliminated. Comparative signal strength is indicated.

## UNDISTORTED HIGH AMPLIFICATION

Three stages of push pull with new system of twin-grid detection allows tremendous undistorted amplification of the high gain I. F. amplifier. The handling power of this system seems to be unlimited and tremendous volume on weak signals can be had if desired.

## AUTOMATIC VOLUME CONTROL.....

There are two paramount advantages in good automatic volume level. First, in tuning from weak to strong signals; and secondly, in holding a steady volume level on fading stations which is so common in short wave reception. The effect of this new Lincoln feature is so efficient that a near-by stroke of lightning registers only a muffled sound in the speaker; it has the same effect on all sharp electrical interference.

## NEW FIDELITY

Twin-grid detection preceded by push pull input I. F. transformers and followed by two stages of transformer coupled push pull stages, produces an undistorted register of a wide band of frequencies, giving a perfectly balanced output with realism hard to associate with radio.

All of the new reactions in the SW-33 model are what we all have wanted for years,—they are here for you today—thanks to Lincoln's foresight in radio possibilities.

## THE NEW DEVELOPMENTS

have made the new DeLuxe SW-33 just about as ideal a receiver as one could hope to own. The use of five variable mu tubes controlled by the new twin grid second detector and followed by two transformer coupled push pull stages has opened the gates to new ideas of enjoyable distant reception.

The signal indicator locates carrier waves which are difficult to hear; many times the carrier is not being used or modulated as is the case in transatlantic phone. The signal indicator registers these silent carriers and enables you to be accurately tuned, ready for the voice to be heard.

WHEN THIS CARRIER IS TUNED, ATMOSPHERIC NOISES ARE REDUCED TO A MINIMUM, AUTOMATICALLY.

Distant stations can be tuned silently, and volume then brought up to desired strength (volume control does not affect sensitivity). Perfect volume level on short wave stations is another great asset in the new Lincoln. If you have ever tuned in a foreign short wave station, or even many of our short wave stations in the U.S.A., you will appreciate the great value of uniform volume level.

The performance of Lincoln equipment has been known the world over for years. Its use by Polar Expeditions, broadcasting stations, both domestic and abroad, U. S. Naval Station operators, and hundreds of super critical DX fans, has proved Lincoln's exceptional merit.

Complete equipment consists of chassis, power equipment, auditorium type speaker and complete set of laboratory tested tubes. Chassis is finished in highly polished nickel over copper and presents a handsome appearance. Precision laboratory construction is employed throughout, and every receiver is tested on distance before shipment.

Write for description of new developments and new sales plan which overcome the present defects in the present custom built radio merchandising.

**LINCOLN**
*DeLuxe Receivers*

LINCOLN RADIO CORPORATION
Dept. SWC-11, 329 S. Wood St., Chicago, Ill.
Please send information on ☐ A.C. ☐ D.C. receivers.

Name ..............................

Address ..............................

City .............................. State ..............

*Print name and address plainly*

(Short Wave Craft - September, 1932)

the 10 meter ham band. Hollister intended this receiver for the amateur market as well as for the non-amateur short wave listener. This set had some excellent features like band-spread tuning on all bands, which was accomplished with a small 3-plate variable condenser, whose dial gave about ten degrees for each degree on the main tuning dial. Although this set looked like it had two tuning controls, one controlled the main dial and the other the bandspread dial. This receiver also had AVC derived from a Wunderlich tube, a meter-type tuning indicator and provided for CW reception by virtue of a beat frequency oscillator. Scott did not try to compete with Hollister on this model and did not introduce his ALLWAVE FIFTEEN until a year later (April, 1934). Even then the ALLWAVE FIFTEEN should not have been seen as competition with the Lincoln R-9, which was actually a communications receiver. Hollister was an amateur radio operator and Scott was not one. As more interest developed in better quality amateur equipment, Hollister evidently wanted to be in that market, but Scott was never keen about building anything specifically for radio amateurs. He preferred to sell to that segment of the public which was willing to pay more for a quality product and which was interested in a combination of DXing and listening to good music either from broadcast stations or phonograph records.

For his 1934 model (SW-34) Hollister decided to put major emphasis on the audio side. He felt that the audio output system must use triodes (Scott felt the same at that time) instead of pentodes and Class B output tubes. He felt that a twin triode tube, type 2B6, best satisfied his needs and used two audio channels with a twin triode in each of them. One channel handled the audio frequencies up to 1000 cycles and the other channel handled the audio frequencies above 1000 cycles. Thus, a large cone speaker was fed by one channel and a smaller high frequency speaker was fed by the other. The remainder of the Lincoln SW-34 receiver (referred to in 1934 advertising as the Lincoln Ultra Deluxe model) consisted of an r.f. stage, 1st detector, oscillator, three i.f. stages and a second detector. Despite the fact that the very first Lincoln receiver, the 8-80, was advertised as a "One-Spot" Super implying that the image signal was eliminated, the inclusion of an r.f. stage in the SW-34 was advertised as a means of eliminating the image signal. On short waves this receiver covered four bands-15 to 30 meters, 30 to 50 meters, 50 to 100 meters, and 100 to 200 meters. Scott competed with this receiver with his ALLWAVE FIFTEEN.

In May, 1935, Scott introduced his 23 Tube Full Range High Fidelity ALLWAVE receiver and was then ahead of Lincoln in emphasizing high fidelity reproduction. For more than a year, Hollister went along with his SW-34 or Ultra Deluxe before introducing the Lincoln Symphonic during the second half of 1935. This receiver was Hollister's competition for the Scott Full Range High Fidelity set. Just as in the Scott equipment, the Lincoln features were divided between short wave DXing and high fidelity. On the short wave side, two r.f. stages were employed in the high frequency bands of this receiver. Two short wave bands, the broadcast band and a long wave band provided frequency coverage from 18 MHz to 150 kHz with some gaps where there was little to listen to. It was said that the signal-to-noise ratio in the short wave radio bands was improved through the use of two r.f. stages and a comparatively low gain in the i.f. amplifier. To cater to both short waves and high fidelity, two separate i.f. amplifiers were used. In one amplifier, two stages were used to provide the necessary selectivity and some gain for short wave reception. In the other amplifier one high gain broadly tuned stage was used for high fidelity listening. Hollister said that one of the most valuable features of the Lincoln Symphonic was the combination of manual controls, which enabled the operator to adjust the receiver to the particular noise conditions surrounding the receiver. He said that by virtue of these controls, the Symphonic could be operated in the short wave bands with lower sensitivity and better signal to noise ratios, which he further stated was a great asset in tuning the short wave bands.

On the high fidelity side the variable bass amplifying circuit was said to give the operator the ability to attenuate or accentuate the bass register to agree with his or her tastes. To obtain more power output over his earlier models, Hollister used four type 45 tubes in push pull parallel. The audio amplifier was rated as capable of delivering twenty five to thirty watts of output with less than five percent harmonic distortion. The tuner unit of the Lincoln Symphonic contained twelve tubes performing the following functions: 2 r.f. amplifiers, 1 first detector, 1 oscillator, 2 in one i.f. amplifier and 1 in the other, 1 second detector, 2 in a first audio stage, 1 in a second audio stage and 1 rectifier. The amplifier unit of this receiver contained six tubes as follows: 2 in an audio driver stage, 4 in the push-pull parallel audio output stage and 2 rectifiers in the power supply of the amplifier.

## McMurdo Silver

Without a doubt, in the long run, Scott's leading competitor was McMurdo Silver. On June 21, 1924 (five months before Scott was to leave for his trip to New Zealand with his specially-built superhet) he moved from New York to open a radio parts store on Wabash Avenue in downtown Chicago. A shop associated with the store provided for the construction of custom built sets and radio repair work in general. McMurdo Silver was known for his work during 1923 on a superheterodyne kit with A.J. Haynes of the Haynes-Griffin Radio Service, Inc., where Silver had worked in New York, and L.M. Cockaday, another nationally-known radio expert of that day.

McMurdo Silver was born in Geneva, New York, in 1903. His father was a professor of ancient history at Hobart College. At the early age of nine, Silver became interested in the "wireless." After his father died in 1916, McMurdo moved with his mother to New York City. By this time he had managed to squeeze out of grammar school, from which he never graduated, and into high school. In three years there, he was a discouragement to his professors, who finally threw him out. Despite all of this poor scholastic performance, at the age of thirteen he had succeeded in having published in a sporting magazine of that day an article of several thousand words on early American firearms, a subject in which he was deeply interested. During World War I while domestic wireless was prohibited, Silver devoted most of his efforts to buying, selling and trading old firearms.

As soon as the ban on amateur activity in wireless was lifted shortly after Armistice Day in 1918, Silver began to experiment with the new tubes, which were developed during the war. At this point his interests in antique firearms and wireless were about equally divided. Early in 1920, he was hired as a laboratory assistant in the tube laboratories of the Westinghouse Group Company at Bloomfield, New Jersey. This work so intrigued Silver that he decided to become an engineer-even with his poor scholastic record when he was younger. At first he requested to be put into an engineering position without further training, but was told that this was impossible. To further his decision he sought to take night courses in engineering at Cooper Union (a college in New York City). However, he could not pass the entrance examinations. Unable to take the engineering courses at once, he started in another night school and soon passed his examinations at the head of one class and as second in another. His aroused interest in radio had turned everything around for him educationally.

Having concluded that advancement would not be fast at Westinghouse, he went to work for a radio and electrical jobber in New York City. He worked there eighteen months and was promoted twice, but wasn't happy because he wanted to be more involved in experimentation and kit building. Along that line he heard that a new company called Griffin Radio Service was to be formed in the Spring of 1922. By summer of that year it became Haynes-Griffin Radio Service through a partnership of A.J. Haynes and John Griffin. Haynes was the key technical man, who introduced his DX tuner, one of the first kit-sets ever developed. Silver saw the superheterodyne as the radio receiver of the future and sold Haynes and Griffin on the idea of developing a superhet kit. In 1923, this effort resulted in the Haynes superheterodyne, for which Silver was said to have built and tested every experimental model. He became a disciple of the superhet, just as Scott became before his trip to New Zealand. He was so excited about the Haynes receiver that he worked day and night on it.

While working at Haynes-Griffin he found that there were several possibilities to be financed in his own business during the radio boom period described in Chapter 2. He hesitated because in every case the investors would control the business. However, in 1921 the unexpected death of his step-grandfather (Frederic Courtland Penfield, who had been US ambassador to Austria just before World War I) resulted in a bequest which gave Silver his opportunity to form a company controlled by him. He bid farewell to Haynes-Griffin and headed for Chicago as mentioned at the beginning of this section. There he organized with a distant cousin, John R. Marshall, a company called Silver-Marshall, Inc. Starting as a store, the company's objective was to sell radio parts and kits composed of such parts. Silver's interest in the superheterodyne could be satisfied by developing kits of his design to be sold through the store and by mail. At this point Silver had not felt the urge to become a major manufacturer of radios, but that was to come later. During 1924 he concentrated on the sale of parts and receiver kits.

Before Scott had even built his receiver for the New Zealand trip in 1924, Silver had placed on the market a seven tube superheterodyne kit. Also, Haynes had come to Chicago in connection with a Haynes-Griffin branch

opened in the Chicago loop. He and Silver wrote a large share of the articles on superheterodynes which appeared in Chicago radio newspapers during 1924. Undoubtedly Scott read these articles, but he did not choose either a Haynes or a Silver superhet kit or any of the parts which they sold. However, the competition of Scott and Silver had not manifested itself at this time. Scott was not yet in the radio kit or parts business, but Silver was already in it with both feet.

Surprisingly, there appeared to be no direct conflict later in the 1920's between Scott and Silver and it was not until the 1930's that a blow-up came. However, a rather unique parallelism developed between their efforts during the 1920's. This parallelism did not exist until Scott went beyond the World's Record Super Nine and Super Ten receivers. Radio Age magazine even used three Silver Marshall audio transformers and a Silver Marshall choke in their World's Record Super Eight, which they wrote about in March 1927. Also, some Silver-Marshall components were used in their World's Record Super Nine, written about in their May-June 1927 issue. A Silver-Marshall midget condenser was used in the parts list of Scott's World Record Super Ten, which was written about in a Radio Age article in October, 1927, and in Scott's ad which also appeared in that issue of the same magazine.

The peculiar parallelism, which I mentioned above, began in the Spring of 1928. It amounted to the fact that either McMurdo Silver or his engineer, Ernest R. Pfaff, would write an article about a new kit and a few months later Scott would appear with a kit having a somewhat similar circuit. Examples are as follows:

March 1, 1928-An article appeared in the Chicago Evening Post Radio Magazine discussing a 4-tube allwave universal tuner, as well as an ad by Silver-Marshall offering it as the 644SG Screen Grid Universal Allwave Tuner. It was actually a complete 4-tube receiver incorporating a screen grid r.f. stage, a regenerative detector and two audio stages. Several ads by constructors also indicated the availability of the kit for $67.50 and also offered to build it.

Later in 1928, Scott brought out a four tube receiver called the Symphony in AC and DC versions. The AC model was similar to the Silver kit but with AC tubes. The DC version was more like a four tube set described in the Chicago Daily News in February, 1928, and did not use screen grid tubes. The Silver kit was for DC operation only-that was one difference.

March 8, 1928- An article appeared in the Chicago Evening Post Radio Magazine describing an 8-tube Laboratory model superheterodyne with screen grid tubes. This article was written by Ernest R. Pfaff, who also wrote an article describing the same receiver in the March, 1928, issue of Radio News. This receiver contained three battery-operated screen-grid tubes in its i.f. amplifier, which was completely shielded by a housing which also covered the second detector. Several ads also appeared in the March 8 issue of the Evening Post offering the parts for this Silver-Marshall receiver as well as offers to build it in some cases. Silver-Marshall also advertised the screen grid i.f. amplifier as a separate shielded unit.

May 1928- Scott introduced his Shield Grid Super Nine, which used essentially the same i.f. amplifier circuit and shielding arrangement. The complete Scott receiver had nine tubes instead of the eight of the Silver-Marshall circuit with an r.f. stage added at the front of the Scott set.

August 1931- An article in Radio News by McMurdo Silver described an Allwave Superhet without plug-in coils. An arrangement to switch the coils within the receiver was provided. Separate dials were provided for short wave and the regular broadcast band.

May 1932- Scott introduced his first allwave receiver without plug-in coils. However, to his credit it incorporated a patented coil switching arrangement and had single dial tuning for all bands. The patented coil switching arrangement was invented by Ernest R. Pfaff, who had by this time joined Scott as his chief engineer. His coil switcher was invented after he left Silver-Marshall and was assigned to E.H. Scott.

These examples may make it appear that Silver upstaged Scott on important receiver circuits during the late 1920's and 1930's and that Scott may have sometimes copied Silver circuits, but there is no proof that Scott even looked at any of the Silver-Marshall kits. In any event, Silver's primary interest was in becoming a large radio receiver manufacturer. Actually he played both sides of the street. He introduced superhet kits and sold them in that form and by 1928 became one of the largest sellers of radio kits and parts distributed through jobbers and dealers in the USA. However, as a manufacturer RCA would not allow him to produce any superhet in his factory. Nevertheless, Silver-Marshall, Inc., was an RCA licensee and manufactured tuned radio frequency receivers like all of the other RCA licensees

of that period.

McMurdo Silver having been in both the radio kit business and the radio manufacturing business, wrote an interesting comparison of the superheterodynes and tuned radio frequency receivers in 1930 just when RCA was finally allowing its licensees to build superhets as follows:

"Looking back, for a moment, through the past eight years, we find that superheterodynes first enjoyed popularity in the fall of 1923, at which time it was possible to build a super of far higher sensitivity than was available in the simple t.r.f. or regenerative sets then being built. The actual selectivity of these old supers, normally five to six tuned circuits, was appreciably superior to that of one or two-tuned circuit regenerative or four-tuned circuit t.r.f. sets, though they suffered from what was then relatively low-powered, uncrowded broadcast conditions, the not very serious drawback of image frequency interference, sometimes called harmonics, plus a variety of other forms of interference manifesting themselves in a multiplicity of dial points at which a single powerful station could be tuned in. Their sensitivity made up for this drawback under old conditions, and it may be said that the real factor of original superheterodyne popularity was sensitivity." He went on to say that while the screen grid tube had been a boon to t.r.f. receiver design, he believed that the superhet would enjoy a new wave of popularity as soon as RCA permitted its licensees to manufacture it.

There is no question that through his own efforts and those of his engineers, McMurdo Silver displayed excellent capabilities in receiver design during the 1920's and early 1930's. His initial downfall was due to his motivation to become a large radio manufacturer. It was announced in January 1929, that Silver-Marshall, Inc., would manufacture a complete line of licensed receiving sets starting in the early Spring of that year. It was also indicated that a large quantity of licensed chassis would be sold under private brand labels. Further, it was stated that Silver-Marshall had no intention of discontinuing the manufacture of parts; the manufacture of receivers was to be in addition to their present activities. By May 1929, Silver-Marshall occupied a modern one-story industrial building of 100,000 square feet with a capacity of 1,000 to 2,000 complete radio sets per day in addition to radio parts, accessories and power amplifiers. McMurdo Silver was beginning to realize his dream to become a large radio manufacturer. However, in retrospect he could not have picked a worse year than 1929 to expand. Silver-Marshall, Inc. went on for more than three years, but in the midst of the Great Depression it was bankrupt in October 1932.

Shortly thereafter a new company, known as McMurdo Silver, Inc., was formed with the objective of offering custom built deluxe receivers with which Scott had been surviving the Depression beautifully and even grown. Only after this time did McMurdo Silver become a real competitor for Scott as they went head-to-head with products which offered similar characteristics. From 1932 to 1937 Silver built a sequence of six receivers, which he called Masterpieces. Many years later they joined the ranks of classic radios along with Scott sets and a few others. They were referred to as Masterpiece I to VI.

McMurdo Silver's Masterpiece I receiver, which was introduced in late October 1932, might have been called the Silver Allwave Fifteen. It had single dial tuning, switched coils, automatic volume control, automatic noise suppression (squelch), an r.f. stage, beat oscillator for code reception, and two -45 type triodes in a push-pull Class A output stage. In four bands it covered 13 to 570 meters (22,600 kHz to 525 kHz). It was competing head-on with Scott's ALLWAVE 12 DELUXE and the Lincoln SW-33. The three additional tubes over Scott's receiver were for the beat oscillator, the squelch circuit and the separate AVC tube. Scott had one more i.f. stage, requiring an additional tube. In terms of number of tubes, this was offset in the Silver receiver by an additional type -80 rectifier.

In the July 1933 issue of Radio News (which appeared in June 1933), Silver ran an ad titled, "Do You Want the *Actual* Facts on *All* Custom Built Receivers?" He stated, "there has been so much controversy concerning the comparative merits of the leading custom built receiver that I have decided to place the true facts before you. A Masterpiece and others have been measured by an independent testing laboratory. The findings have been authenticated by unbiased authorities. This information....these incontrovertible FACTS.... together with the complete story of the Masterpiece will be sent you upon receipt of 6 cents in stamps. Please use the coupon." In this report, Silver compared three receivers, which he labeled A, B and C. In reading the report, Scott identified them as the Scott ALLWAVE 12 DELUXE, the Lincoln SW-33 and the Silver Masterpiece in that order

of the assigned letters. In the report, Silver showed that his Masterpiece receiver was superior to the other two receivers.

In addition to identifying the receivers, Scott blew his stack and moved swiftly to counteract the Silver Report. First, he pointed out that the engineers who had attested to the superiority of the Silver Masterpiece receiver were at least formerly (if not currently) associated with Silver in the Silver-Marshall Company and still close by. Second, he arranged to have his receiver tested by an independent consulting engineer (a truly independent engineer not associated and never associated with Scott in any way). Scott released the data from these tests, which reached the following conclusions:

1. The Scott receiver was 50% more selective than the Silver receiver at 1000 kHz.
2. The Scott receiver had 4 times the sensitivity of the Silver receiver.
3. The Scott receiver had 35% less noise than the Silver set.
4. Neither set had ideal automatic volume control characteristics.
5. With regard to fidelity, the Silver receiver was slightly better from 60 to 200 cycles and slightly better from 2,500 to 5,000 cycles. However, the testing engineer thought that the Scott receiver would probably sound better because it would have less hiss and noise level in the range from 3,000 to 5,000 cycles. (It was apparent from the fidelity curves that neither receiver approached anything like what was to be called high fidelity later.)

In the covering letter which Scott sent out with his engineering report, he stated that he was suing McMurdo-Silver, Inc. for $100,000.

It did not appear that this action had much to do with resolving the severe competition between Scott and Silver. As the controversy raged on into the autumn of 1933, Silver was not deterred from introducing a new receiver, which he called the Masterpiece II. In it he reduced the number of tubes from 15 to 12, added bandspread tuning on short waves, eliminated the squelch circuit which was used in Masterpiece I and increased the power output by changing the tubes in the output stage. One tube was eliminated by using a combination mixer-oscillator-that is, dispensing with a separate oscillator. Another tube was eliminated by removing the squelch circuit. Due to its greater power capacity, a single rectifier type 5Z3 replaced a pair of type -80 rectifiers. The first audio stage was reduced to one tube instead of the two in push-pull in the Masterpiece I. By this calculation four tubes would have been eliminated in the Masterpiece II vs. the Masterpiece I. However, an i.f. stage was added, so the total was twelve tubes in the new model.

The addition of an i.f. stage in the Masterpiece II could have improved its sensitivity and selectivity to counteract the charge against the Masterpiece I made in tests sponsored by Scott in the summer of 1933. In dropping the squelch circuit, Silver indicated that its control could often be set to cut out stations which had sufficient strength to provide good reception. While it could be set for silent interstation tuning, it could be set to eliminate signals in such a way that the user would not realize that they were even there as he or she tuned across the dial. This feature was not criticized or even mentioned in Scott's comparative report, but could well have been so indicated. By late Spring of 1933, Silver changed to the 2B6 triode in the audio amplifier of the Masterpiece II. This was the tube which Hollister of Lincoln Radio Corporation rated so highly for his SW-33.

In advertising the Masterpiece II, Silver made much of the fact that Admiral Byrd had one of these receivers with him on his Antarctic Expedition. To broaden his product line beyond a single Masterpiece model, Silver introduced a nine tube allwave superhet (The World Wide Nine) during mid-1934. By using a type -55 tube, which combined second detection, AVC and first audio amplification and reducing the number of i.f. stages to two, Silver was able to provide a receiver which was not greatly inferior to the Masterpiece II, but which was somewhat less expensive. It covered all short wave bands down to 13 meters and up through the AM broadcast band to 560 meters. However, it did not have spreadband tuning, but had a dual ratio 270 degree airplane dial with an 8:1 ratio for the AM broadcast band and a 40:1 ratio for the shortwave bands. Silver offered it at $89.00 net complete with loudspeaker and tubes, and stated in his advertising that it was the only custom built allwave receiver offered at a low price.

On a sort of annual basis Silver introduced another of his Masterpieces during the autumn of 1934. This one was the Masterpiece III. Announcing this model, Silver stated that some new developments warranted its introduction to supersede the Masterpiece II. However, he made the most comment about the new dial known as an "airplane" dial or a "watch" dial

CABLES "SCOMACO" CHICAGO

# E. H. SCOTT RADIO LABORATORIES

4450 RAVENSWOOD AVENUE

CHICAGO, ILLINOIS

Date: 7/18/33

To the Radio Public:

It is with extreme regret that I find myself forced to the necessity of issuing this leaflet. I have always considered competition a good thing in business, but when that competition takes the form of issuing false and misleading information about a competitor's product, in an endeavor to secure business, then competition ceases to be a good thing.

Judging from the number of letters that have come into my office during the past two weeks, an "Engineering Report" by the Clough-Brengle Company and distributed by McMurdo Silver, must have been sent out by thousands all over the country.

If the information given in the McMurdo Silver pamphlet were authentic and correct, then you could only decide the Masterpiece receiver must be superior to the other receivers described in this report, one of which, Super Het "A", is supposed to represent the performance of the Scott Allwave DeLuxe.

As a matter of actual fact, the performance of the Scott Allwave DeLuxe receiver is in every way superior to that of the McMurdo Silver Masterpiece, as is very conclusively proven by an Engineering Report, made by one of the most highly qualified radio engineers in the industry, who has just completed a very careful laboratory test of all receivers mentioned in this report.

I might state that I have filed suit in the Circuit Court this day against McMurdo Silver Inc. for $100,000 damages.

I sincerely hope that the necessity will never again arise, in which I will be compelled to reply to such a report as that circulated by McMurdo Silver.

EH Scott

President

E. H. SCOTT RADIO LABORATORIES INC.

EHS:EM

because of its two hands or pointers which traveled at totally different ratios. While the tuning knob was pushed in, the desired short wave band was selected. Then by pulling out the knob, the second pointer tuned in a spreadband fashion with a 100:1 ratio. On the circuit side there were no major changes. The r.f. coils were redesigned to provide greater gain in that stage and the circuit feeding the first detector. In the audio output stage 2B6 output tubes were replaced with 2A5s operating as triodes in Class A push-pull to provide 18 watts of audio at less than 5% distortion.

In August of 1935 the Masterpiece IV appeared as a significant step-up over the Masterpiece III. Containing seven more tubes than the latter for a total of nineteen, it incorporated primarily an improved audio system utilizing seven tubes compared to three in the earlier model. A three stage audio system in the Masterpiece IV followed the second detector with a type 76 voltage amplifier which had bass and treble compensation (or boost as it was often called) controllable by separate bass and treble tone controls. From there the signal fed through a tuned push-pull transformer to a pair of type 42 tubes triode connected in Class A push-pull serving as an audio driver stage. It fed four type 42 tubes in a triode connected Class A Prime power output stage. This audio amplifier could be adjusted by means of the two tone controls to be flat from 30 to 9000 cycles, or to be up 8 db. at the bass and treble ends or to be down 30 db. at the bass and treble ends for very weak signal reception in noisy locations. Harmonic distortion was below 1% at 10 watts output, below 2% at 20 watts and below 5% at 35 watts. This output stage fed two speakers; a 13-inch bass unit covering the range of 30 to 40 cycles and a 5½ inch high frequency speaker covering on up to 9000 cycles. A crossover filter separated the two speaker inputs in the 3000 to 4000 cycle range. The tube difference between the Masterpiece IV and the III was four tubes in the audio amplifiers, 1 additional r.f. amplifier, an additional tube as an oscillator due to the use of a straight mixer and not one with combined mixing and oscillation, and one additional type 5Z3 rectifier in the power supply.

Introduced in 1935, the Masterpiece IV was to compete with Scott Full Range High Fidelity ALLWAVE 23 and the Lincoln Symphonic. Silver tried to steal a march on both of them by bringing out the Masterpiece V in July, 1936. This set had several changes in tube types over the Masterpiece IV in some instances to make possible the use of the new metal tubes (their elements were encased in a metal shell instead of a glass envelope). Silver had substituted as many metal tubes as possible in the Masterpiece IV during 1935. Aside from the tube type changes, the main change was the addition of a volume expander. Scott was also using a volume expander, but was offering it as a separate unit to be connected externally to the Full Range ALLWAVE 23. Of course, in the Scott sets, it was included in the cabinet with the other chassis and the controls were brought out in such a way that there was no difference to the customer whether it had been on the main chassis or not.

In a similar fashion to the Scott News, which was published usually on a monthly basis, Silver published the Silver Times. In both of these publications, an effort was made to keep the prospective customers as well as current owners informed of new models, features and company news. In the July 1936 issue of the Silver Times, it was stated that the Masterpiece V was the World's Only Truly Custom-Built Radio. It developed that Silver was on relatively weak ground in that claim. In response to a query from a reader of the Silver Times he had written:

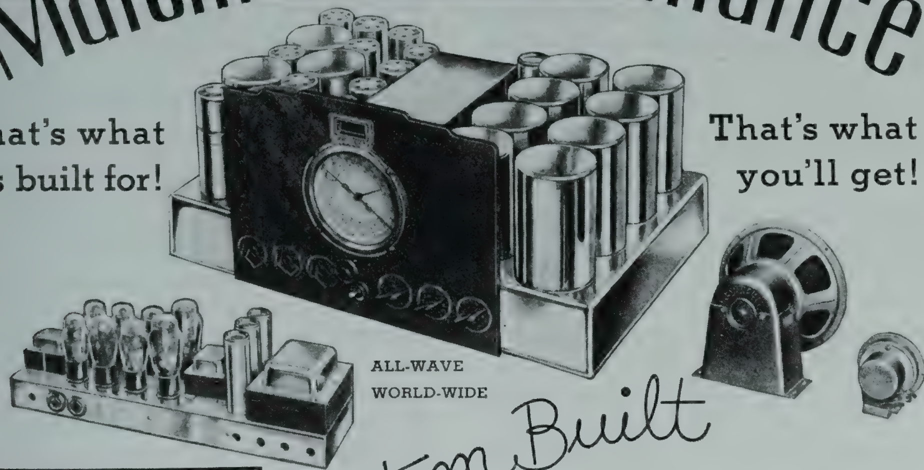
> **"In actual fact, the Masterpiece V receivers are assembled in a special division of the Howard Company plant for license reasons. We are not an RCA licensee, (author's note-Silver-Marshall, Inc. had been an RCA licensee, but McMurdo-Silver, Inc. had not obtained an RCA license since its formation in 1932.) ... In no sense is the apparatus so custom built to be confused or compared with any apparatus built by the Howard Company in its regular line of business. Upon completion of these receivers, they are brought by us to our laboratory at the above address, less than three blocks from the Howard plant, where final testing and adjustment to each receiver's individual specifications is done by our staff and the writer."**
>
> **(signed) McMurdo Silver**

Scott's view was that Silver was neither a custom builder nor even a manufacturer under the circumstances; that his Masterpiece radios were factory made by the Howard company and that Silver had completely misrepresented his product. At this point in the era of custom-built radios, Scott's view made a lot of sense, but since then, it has become quite common to farm out the production of the highest quality radio

# Matchless Performance

That's what it's built for!

That's what you'll get!



ALL-WAVE
WORLD-WIDE

*Custom Built*

## SILVER MASTERPIECE IV

Tried and tested by critical owners the world over . . . years ahead of contemporary design . . . the amazing MASTERPIECE IV thrills and delights listeners with its brilliant performance under every conceivable reception condition. Truly, it has proved itself to be the "Rolls-Royce" of radio . . . the finest receiver of all time!

Engineered to achieve certain definite results—not merely "tricked up" to provide a background for intriguing words and phrases—McMurdo Silver's latest and greatest MASTERPIECE is everything the name implies. That's why we can dare to offer it under a definite guarantee that it must **prove** its superiority in comparison with any all-wave receiver at any price, with you the sole judge, as have been users from the F. C. C. to broadcasters, engineers and DX champions.

With unlimited distance range, freedom from inherent noise, fading and interference, great power without distortion, unequalled lifelike fidelity and richness of tone, and a tuning scale covering every broadcast service on the air, the MASTERPIECE IV is built to bring you the finest and most exciting radio entertainment you have ever known.

### 25 STARTLING ENGINEERING ADVANCEMENTS

- 19 Tubes, providing twenty-three distinct tube functions.
- Perfected Circuit.
- Unmatched Flexibility of Control.
- Unequalled freedom from noise.
- Selectivity, extreme and variable.
- Unmatched Tone Quality.
- Double High Fidelity.
- 35 Watt Undistorted Output.
- Amplified Automatic Volume Control.
- Airplane Dial with 5 accurately calibrated tuning scales.
- Band Spread Tuning.
- 2 Tuned R.F. Stages on all 5 bands.
- Air Dielectric Trimmer Condensers throughout.
- No-loss R.F. Inductances.
- All R.F. and I.F. circuits Air Tuned.
- Doubly Amplified Tuning Meter.
- Calibrated Sensitivity Control.
- Complete Circuit Isolation.
- Completely Shielded.
- Public Address and Phonograph Operation.
- No Microphonic Howling.
- Two Matched Speakers.
- Every Part Individually Tested.
- Complete Professional Flexibility.
- One Year Free Service.

PLUS—Many other important basic features which have won world-wide acclaim for previous MASTERPIECES.

Mail the coupon TODAY for a Free copy of the 32-page "Blue Book of Radio," with complete technical description, proofs of performance, 10-DAY TRIAL and 5-YEAR GUARANTEE.

### TRY IT FOR 10 DAYS

Try the MASTERPIECE IV for 10 days in your own home or laboratory, under your own reception conditions. If it fails to meet your every expectation, return it undamaged and your money will be promptly and cheerfully refunded, less only transportation charges.

### SEND TODAY


for Free "BLUE BOOK OF RADIO"

### SCOOP . . . R9 + ANTENNA

The new R9 + Antenna not only eliminates noise, but increases volume of all s. w. stations from 4 to 5 times. Easy to put up, and costing only $8.85 net, it is the first tuned short wave antenna available. It's like adding a stage or two of r. f. to any standard all-wave receiver! Check and mail the coupon for complete details.

McMURDO SILVER CORPORATION
3352 N. Paulina Street, Chicago, U. S. A.

☐ Send Free "BLUE BOOK" giving complete specifications of MASTERPIECE IV, with details of 10-DAY TRIAL

☐ Send description of R9 + Antenna.

Name ..............................

Address ..............................

City .............................. State ..............................

12-RN

## McMURDO SILVER CORP.

Division of G. P. H. Inc.

3352 N. Paulina Street Chicago, U. S. A.

(Radio News - December, 1935)

and audio products and label them with the name of the seller. In terms of the custom built concept to which Scott hewed with utmost devotion, it was undoubtedly sacrilegious for Silver to use these methods. Actually, since he had no RCA license he had little choice if he wished to stay in business. It is not likely that the assembly of the receiver in another location from where it was finally adjusted and tested did little if anything to impair its performance. There were a number of other claims made by Silver which were castigated in Scott's letter and in some cases rightly so.

Almost on schedule as he had done annually since 1932, Silver introduced his Masterpiece VI in October of 1937. Circuitwise this set did not appear to be much different than the Masterpiece V. In his articles about it, Silver tried more than ever to convince people that it was truly custom built and subject to many variations to suit the desires of the customers. Unfortunately, another Masterpiece did not come on schedule in the autumn of 1938, but instead bankruptcy overtook Silver again much as it had in Silver-Marshall. Scott acquired the assets of the company shortly thereafter. Silver ceased to be a competitor of Scott, but he went on with the Guthman Company in Chicago to design low-cost communications receivers and kits and some test equipment.

Although hardly a long term success in the radio business, McMurdo Silver advertised that he was officially credited with 40 major radio achievements, which ranged all the way from the first practical and popular superheterodyne in the world in 1923 to the first "Class A Prime" high fidelity audio power amplifier in 1933. Although one might have thought that there would have been considerable conflict between Scott and Silver over these claims, more than half of Silver's claims were for accomplishments prior to 1928. Scott's major claims up to that time were his reception records in New Zealand in 1925. There was no way that Silver could challenge these claims. Starting in 1928 there were claims and counterclaims between Scott and Silver about the first allwave receiver; a direct conflict about who was first with a 15 to 500 meter superheterodyne without plug-in coils; a conflict over who used screen grid tubes successfully first and who used triple grid "super control" tubes first. To Silver's credit he was already in the superhet kit business before Scott went to New Zealand and had been directly involved in the creation of the Haynes superhet in 1923. During the 1920's and later he was a prolific writer describing his circuits in the national radio magazines and local newspaper radio sections and magazines. There is good reason to believe that most of his early claims were valid.

## Avery Fisher

About the time that Lincoln Radio Corporation and McMurdo Silver were fading out in 1937, Avery Fisher started a company called the Philharmonic Radio Corporation in New York City. He specialized completely in the high fidelity reproduction of AM radio broadcasts and phonograph records utilizing a tuned radio frequency tuner and a 25 watt beam power audio amplifier. In a sense this was not competition for Scott, except for the listener who was interested only in high fidelity in 1938 and 1939. It is said that the high fidelity sets made by Fisher at that time were in such demand that he could not make enough of them to satisfy it. A radio phonograph made by Fisher in 1937 was accepted by the Smithsonian Institution in Washington as America's first commercially manufactured high fidelity unit.

In my opinion, E.H. Scott was the pioneer of high fidelity in home receivers. He was building high fidelity into such sets in 1935 and 1936 before Avery Fisher started his first radio company in 1937. However, Scott featured DX reception capabilities in all of his receivers so they were not devoted exclusively to high fidelity like the Fisher products.

## Midwest Radio

Another company, while hardly a competitor, deserves mention. That was the Midwest Radio Corporation of Cincinnati, Ohio. They deserve mention because they advertised in the same magazines as Scott, Lincoln and Silver and sometimes their full page ads appeared on opposite pages to the leaders. Selling directly by mail at the lowest possible cost, Midwest offered a sixteen tube allwave superhet chassis for less than $50.00 in 1933. In 1935 they offered an eighteen tube allwave superhet at $59.50 less cabinet and tubes. The latter receiver had six tuning ranges, many of the features of the better sets and was labeled as capable of high fidelity reproduction. In their advertising they never claimed tonal perfection, but stated that orchestra leaders like Fred Waring, George Olson, Jack Denny and

Ted Fio Rito used Midwest sets to study types of harmony and the rhythmic beats followed by leading American and foreign orchestras of that day. In 1936, Midwest offered a 24 tube allwave superhet with 40 watts of audio output with emphasis on DX capability and high fidelity reproduction. Magazine writers tested these sets and generally wrote favorably about them. Perhaps the best comparisons made by the writers were that the Scotts, Lincolns and Silvers compared to Cadillac and Lincoln automobiles, while the Midwest sets at much lower prices were “Flivvers” and “Chevies” of the day. While Scott undoubtedly lost some sales to Midwest, it was not considered to be in the same league since its products were cost-oriented, not claimed to be custom built and available only by mail order.

# AMERICA TURNS TO MIDWEST!

## AMAZING NEW SUPER-DELUXE

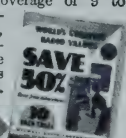
# 16-TUBE ALL-WAVE Radio

## (9 TO 2000 METERS - 5 WAVE BANDS)

## *Is First Choice of Thousands of Radio Fans!*

### Big FREE Catalog Shows Sensational Radio Values

BEFORE you buy any radio, write for this big new FREE Midwest catalog . . . printed in four colors. It has helped thousands of satisfied customers save from 1/3 to 1/2 on their radios . . . by buying *direct* from the Midwest Laboratories. You, too, can make a positive saving of 30% to 50% by buying a Midwest 16-tube de luxe ALL-WAVE radio at sensationally low direct-from-laboratory prices. You'll be amazed and delighted with its super performance! Broadcasts from stations 10,000 miles and more away are brought in . . . "clear as locals." You get complete wave length coverage of 9 to 2,000 meters (33 megocycles to 150 KC.) Now, you can enjoy the new DX-ing hobby . . . and secure verifications from world's most distant radio stations.



WRITE FOR NEW FREE CATALOG

This Midwest ALL-WAVE Radio has FIVE distinct wave bands: ultra-short, short, medium, broadcast and long . . . putting the whole world of radio at your finger tips. Now listen in on all U. S. programs . . . Canadian, police, amateur, commercial, airplane and ship broadcasts . . . and programs from the four corners of the earth. Thrill to the chimes of Big Ben from GSB, at Daventry, England—tune in on the "Marseillaise" from FYA, Pontoise, France—hear sparkling music from EAQ, Madrid, Spain—enjoy opera from 12RO, Rome—listen to the call of the Kookaburra bird from VK2ME, Sydney, Australia. Listen to Admiral Byrd's broadcasts from "Little America." Taylor, of Ocean Beach, California, wrote: "Heard KJTY, U. S. S. 'Bear', Byrd Expedition . . . near New Zealand, broadcasting phone conversation to U. S. A," etc. **Never before so much radio for so little money! Write for FREE catalog.**

**FOREIGN STATIONS COME IN LIKE LOCALS**

*Crawfordsville, Ind.* — I have heard HVJ, Vatican City, Italy; DJB, Zeesen, Germany; and YVIBC, Venezuela. They came in with the volume and clearness of any local station. I logged stations from Canada to Cuba, from coast to coast. JESSE BALLINGER, 207 Bluff St.



### 30-DAY FREE TRIAL PLAN STARTLES RADIO WORLD!

Try the Midwest radio you select from the free catalog . . . in your own home . . . for 30 days before you decide. Midwest can afford to make this sensational offer because, when you see and hear this bigger, better, more powerful, clearer toned, super selective radio you will want to own it—as so many thousands of men and women have done.

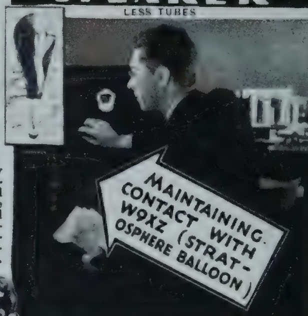
### "40 NEW 1934 FEATURES"

See for yourself the 40 new 1934 features that insure amazing performance. Here are a few of these features: Automatic Select-O-Band, Amplified Automatic Volume Control, 16 New Type Tubes, Balanced Unit Superheterodyne Circuit, Super-Power Class A" Amplifier, 29 Tuned Circuits, New Duplex-Diode-High Mu Pentode Tubes, Full Rubber Floated Chassis, Centralized Tuning, 7 KC. Selectivity, New Thermionic Rectifier, Automatic Tone Compensation, Auditorium Type Speaker, etc. These features are usually found only in sets selling from $100 to $150.

**WORLD'S GREATEST RADIO VALUE**

**$59.50 with New *Deluxe Auditorium Type* SPEAKER**

LESS TUBES





Recently, the Official Radio News Observer for Pennsylvania reported that his Midwest Super De Luxe 16-tube ALL-WAVE radio maintained contact with W9XZ (Stratosphere Balloon) when other sets lost signals.

### NEW STYLE CONSOLES

Write quickly for your FREE copy of the new Midwest catalog. It pictures a complete line of beautiful, artistic de luxe consoles and chassis... in four colors! Sensational low prices save you 30% to 50%. You can order your Midwest radio from this catalog with as much certainty of satisfaction as if you were to select it personally at our great radio laboratories. Write TODAY!

**TERMS AS LOW AS $5.00 DOWN**

### DEAL DIRECT WITH LABORATORIES

## SAVE UP TO 50%

Increasing costs are sure to result in higher radio prices soon. Buy before the big advance . . . NOW, while you can take advantage of Midwest's amazingly low prices. No middlemen's profits to pay! You save from 30% to 50% when you buy direct from the Midwest Laboratories ...you get 30 days FREE trial—as little as $5.00 down puts a Midwest radio in your home. Satisfaction guaranteed or your money back. Our FREE catalog shows sensational radio values. Write for it TODAY!

**MIDWEST RADIO CORP.**
DEPT. 491 — CINCINNATI, OHIO, U. S. A.
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**MAIL COUPON TODAY! FOR AMAZING 30-DAY FREE TRIAL OFFER AND NEW 1934 CATALOG**

MIDWEST RADIO CORP.,
Dept. 491
Cincinnati, Ohio.

Without obligation on my part send me your new FREE 1934 catalog, and complete details of your liberal 30-day FREE trial offer. This is NOT an order.

AGENTS! Make Easy Extra Money
Check Here for Details ☐

Name..........

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City.......... State..........

(Radio News - April, 1934)

# Chapter 8
# Multi-Featured Radios

## High Fidelity Emerges

In 1928, Professor L.A. Hazeltine, the inventor of the Neutrodyne, wrote an article titled "Your Money's Worth in Radio." Discussing various characteristics of receivers such as sensitivity, selectivity, convenience of operation and fidelity, his comment on fidelity was as follows:

"Absolute faithful reproduction of music and speech over the entire audible range is not desired by the listener. Comparatively little of the important components of music and speech, but a great deal of disturbing noise, is comprised in frequencies above 5000 cycles per second. Likewise, components below about 100 cycles per second are hardly recognized, but may include objectionable alternating current hum or may give rise to serious overloading."

Although various moves were made toward high fidelity reproduction in home receivers during the 1930's and 1940's, it appeared that key engineers of some of the largest radio manufacturers agreed with Prof. Hazeltine until the early 1950's. It was then that high fidelity really took off and spawned, along with stereo, an almost unbelievable interest level. My experience was that until that time, the key engineers of the large manufacturers believed that a receiver that reproduced only 100 to 5000 cycles was quite adequate for the radio public. This frequency range was typical of the audio systems found in most manufactured receivers through the 1930's and beyond.

Going back to 1935 to keep continuity in our story, the high fidelity that could be realized in a home radio-phonograph depended on the source material then available. There were only two such sources; one of these was the broadcasts of AM radio stations and the other was the audio signal which could be extracted from 78 RPM phonograph records. When one considers the source material available in the mid-1930's, Prof. Hazeltine and later authorities had a reasonable basis for their attitude about high fidelity. The needle surface noise in 78 RPM records of that vintage was sufficiently intense to disturb record reproduction above 5000 cycles. Only strong local AM stations which made an effort to provide high quality audio modulation could do so. The 10 kHz spacing of frequency assignments in the broadcast band relegated weaker signals to interference in the higher audio range. FM and tape recording had not reached beyond the laboratory stage.

Despite the above limitations, considerable effort was put forth during the period of 1934 to 1939 to realize some degree of high fidelity reproduction in radio receivers and radio-phonographs by Scott and some of his more direct competitors (see Chapter 7). A number of improvements had to be made if optimum fidelity was to be realized from the available source material. On the radio side, these included variable selectivity, noise reduction, and improved automatic volume control. On the phonograph side, they included the suppression of "needle scratch" noise and an effort to induce record manufacturers to use materials of lower noise output in record manufacturing. For both radio and phonograph reproduction, improved audio amplifiers and loudspeakers capable of more faithful reproduction at low distortion levels were in continual development.

In 1934, the better class of broadcast stations were equipped to handle an audio band of 8,000 to 10,000 cycles. Radio City in New York was equipped to broadcast an audio band of 15,000 cycles. High fidelity recordings, covering a band of 50 to 8,000 cycles or better, were broadcast regularly. New microphones flat to 15,000 cycles were being used. Wireline networks equalized to 8,000 cycles had been in regular service for some time. So it was apparent that radio sets and radio-phonographs which reproduced only up to 5,000 cycles were not doing justice to the source material.

## Murray Clay Comes Aboard

Murray Clay joined the E.H. Scott Radio Laboratories as Chief Engineer during November, 1934. From then until his departure in May, 1938, he developed three receivers which rank high on collector's lists.

E.H. Scott and Murray Clay (Front Left) At American Patent System Centennial - November 23, 1936

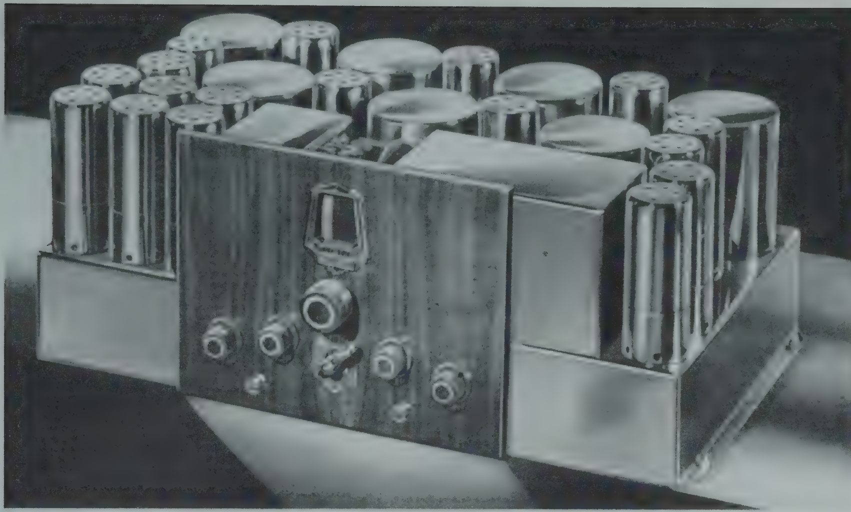
After graduating from Lafayette College in Pennsylvania with a degree in electrical engineering, he worked for RCA for four years. In the last two years before joining Scott, he worked in RCA's License Laboratory. The purpose of this laboratory was to assist receiver manufacturers, licensed by RCA, in applying RCA patents to their new models. They also performed overall measurements on receivers to assure manufacturers that optimum performance was being realized.

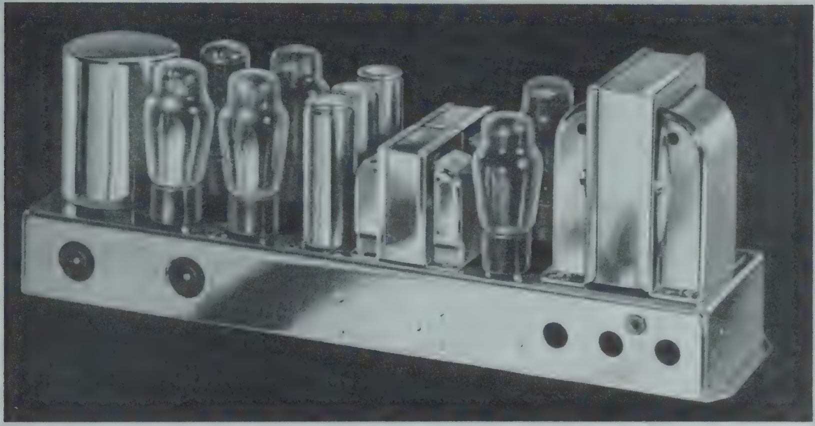
In his experience with the RCA License Laboratory, Murray had seen receivers in the industry that met the average characteristics that satisfied Professor Hazeltine. Once at Scott, he embarked on designs capable of high fidelity reproduction. However, he realized that if full range audio reproduction of broadcast signals and phonograph records of that period were to be realized, improved signal-to-noise ratios were necessary. Murray developed circuits and components which implemented noise reduction, as well as high fidelity. Patents were granted for most of them. Many high fidelity features were introduced in the Full Range ALLWAVE 23 receiver, which first appeared in May, 1935. However, it was not until 1938 that these developments were fully reflected in the Philharmonic.

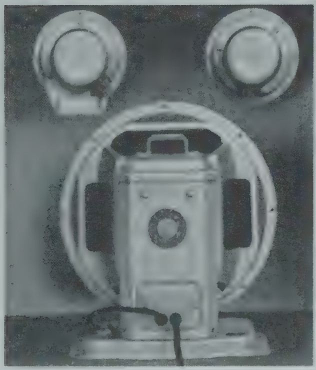
The Full Range ALLWAVE 23 retained all of the short wave features of the ALLWAVE FIFTEEN and even incorporated a few additional ones as well as features to provide improved audio fidelity. It was said that anyone who was interested in high fidelity reception on both the broadcast and short wave bands and who needed maximum sensitivity for DX work as well as variable selectivity ranging continuously from wide band characteristics all the way to hair-splitting sharpness, would be more than interested in this Scott receiver. One might have thought that the benefits of variable selectivity, which could be varied continuously to provide an audio bandwidth of from 2 kHz to 16 kHz, would be useful in the broad position only in the AM broadcast band, but I found it often useful in short wave listening to be able to open up the fidelity from the sharper positions. The accentuation of high audio frequencies, which would result, often made the foreign voice broadcasts much more intelligible than they would have been with the high audio frequencies attenuated. Of course, the prime objective of variable selectivity was to provide high fidelity in the broadcast band and sharp selectivity in all bands where DXing was practiced in the presence of adjacent channel interference.

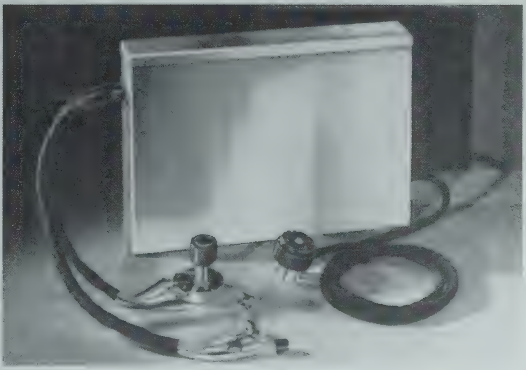
The Full Range ALLWAVE 23 also incorporated a Noise Suppressor. However, in this case it was neither a record scratch suppressor or a peak noise limiter like the one to be used in the Scott Philharmonic later. In the presence of strong noise signals, it would bias back the i.f. amplifier and cause a temporary reduction of the receiver sensitivity. In this sense, its purpose was quite similar to one of the suppressors used later in the Scott Philharmonic receiver, but it was not as effective.

To take full advantage of variable selectivity, an entirely new audio system was designed for the Full Range ALLWAVE 23. Its response of 30 to 16,000 cycles was necessary to provide for full range high fidelity. To handle the output of such an amplifier a speaker system with a specially designed high frequency unit was necessary. To make possible the reproduction of peaks and loud passages of music without distortion, the power handling capacity of the audio output stage was increased from 15 to 35 watts. It was felt that average power might not exceed six watts most of the time, but that there were often dozens of passages in a single program where the peaks or loud passages rose to as high as 30 to 40 watts. Thus, reserve power of about six times the normal level was necessary to handle the sudden "peaks" in musical or speech reproduction. The audio power amplifier in the Full Range ALLWAVE 23 could go from 35 watts Class A to 50 watts Class AB. Another development was the volume expander, which enabled the receiver to handle even greater ranges of audio level and especially to restore compressed musical passages on phonograph records or in broadcast programs where they were compressed to limit the modulation of the transmitter. The circuit and tubes required for this expander were such that they could not be added readily









**Full Range High Fidelity (ALLWAVE 23) Receiver Chassis(Top)**
**Mating Power Supply/35 Watt Audio Amplifier (Center)**
**Triple Speaker System (Bottom Left) & Program Volume Range Expander (Bottom Right)**

to the Full Range ALLWAVE 23 chassis, so the volume expander was offered as a separate unit at that time.

The eight additional tubes in the Full Range ALLWAVE 23 over those in the ALLWAVE FIFTEEN were as follows: one 4th IF amplifier, two in audio amplifier, 1 rectifier, 1 noise suppressor, 1 RF AVC, and 2 voltage regulators.

With increased emphasis on high fidelity, Scott decided that it was necessary to go beyond printed literature to bring such features before the potential listeners. He stated in his literature that it was impossible to show in printed matter the high quality of the parts and workmanship of a Scott Custom Built Receiver and equally difficult, without listening to one, to obtain an adequate idea of their outstanding performance, both in the reception of programs from distant foreign stations in all parts of the world, and their fine tone. In December of 1935 he opened a Salon in New York City at Rockefeller Center to give prospective purchasers in Eastern USA an opportunity to hear the superior performance of Scott receivers and enable them to obtain some idea of the beauty, the fine woods and finish, and the craftsmanship of the distinctive console cabinets designed for Scott radios.

Shortly after announcing the opening of the New York Salon, Scott said that many requests were received from prospective purchasers on the West Coast urging him to open a similar Salon there. In February, 1936, he found a location in Los Angeles where a combined Sales Salon and a Service Laboratory could be accommodated and opened such facilities there. Prior to the opening of these outlets, all Scott receivers had been sold either by mail order or directly from the listening studios at the Chicago Laboratory. Following the East and West Coast Salons, three others were established-one on North Michigan Avenue in Chicago for the convenience of downtown shoppers, one in Detroit, and one in Buffalo. In each of these cities service facilities were also provided but not necessarily in the same location as the Salon. Of course, in Chicago the service facilities were at the company headquarters on Ravenswood Avenue, where several demonstration rooms were provided.

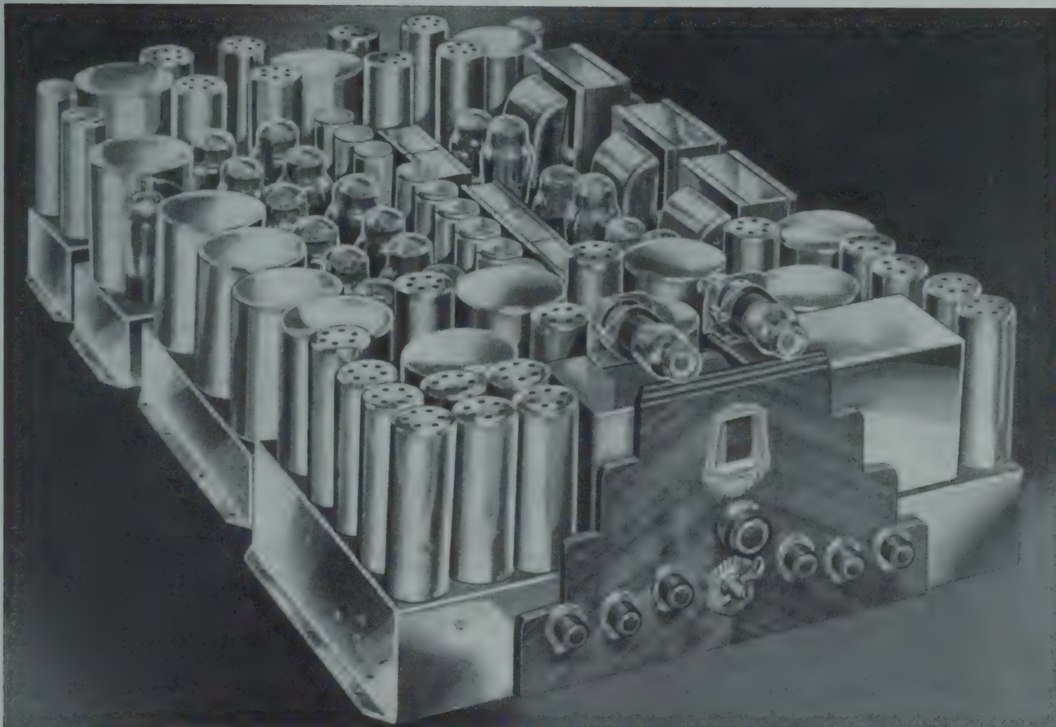
## Special Sets and Special Installations

The listening facilities provided at the Salons as well as wider product distribution led to an increasing recognition of the superior tonal quality and general performance of Scott's receivers and a demand for special installations and in some cases special combinations of tuners and amplifiers. Using the RF and IF sections of the Full Range ALLWAVE 23, Scott built two combinations of equipment, one utilizing 40 tubes and the other 48 tubes, to satisfy the latter demand. In both cases, the volume expander was added to form part of the equipment, but most of the additional tubes were in special audio amplifiers.

In the 40 tube versions, known as the Quaranta, two separate audio channels were provided. One of them handled the middle and high audio frequencies (125 to 16,000 cycles) with a filter to eliminate bass frequencies. The other channel handled the range of 30 to 125 cycles through a bandpass filter to eliminate the higher frequencies. The former utilized eight tubes and the latter used twelve tubes. The high and mid range channel delivered 50 watts of undistorted power, while the low frequency channel had a peak power output of 50 watts. The low frequency channel fed a single cone speaker of special design while the high and mid range channel fed a smaller cone speaker and two high frequency horn units mounted near the top of the separate loudspeaker cabinet.

The 48 tube receiver similarly used the RF and IF sections of the Full Range ALLWAVE 23 and the volume expander was followed by three separate audio channels. Starting with the lowest audio frequencies the first channel handled 30 to 125 cycles and fed an 18" cone speaker. The second channel handled 100 to 6000 cycles and fed two 12" cone speakers, while the third channel passed 3000 to 16,000 cycles and fed two special high frequency horn speakers. These amplifiers supplied power levels comparable to those of the Quaranta.

The Quaranta was built at the request of a lady who had initially listened to the Full Range ALLWAVE 23 at the home of a friend. Later while visiting some friends in Chicago, she called Scott and gave him an order to build the finest set regardless of cost. In 1935 an expansion of the Full Range ALLWAVE 23 was his logical choice. It was completed and delivered to her estate in time to be presented as a Christmas gift to her husband in that year. In early 1936 Scott built the 48 tube receiver for a customer living on a large ranch in the Santa Ynez Valley of California. The three channels of audio amplification in it provided for a better distribution of output among loudspeakers suited for each frequency range in which they worked. Also separate control of the three channels provided a greater flexibility in the adjustment of tonal balance. In



48 Tube Scott Quaranta Comprised Of 19 Tube Tuner, 12 Tube Dual Channel Power Amplifier, 7 Tube Recording Amplifer and 10 Tube Mid-Amplifier/Crossover (Top) Quaranta Five Speaker Set, Automatic Record Changer, Recording Equipment and Ribbon Microphone(Bottom)

INTERIOR VIEW LOS ANGELES STUDIO

INTERIOR VIEW LOS ANGELES STUDIO

INTERIOR VIEW NEW YORK STUDIO (Below)

# For the radio thrill of your

NOW, that you have glanced through this book and have read a few of the enthusiastic letters it contains, I am sure you will want to know where you can hear and see this remarkable instrument. If you live near New York, Chicago, Los Angeles, Detroit, or Buffalo I urge you to call at our Demonstration Studios as my guest, any day (except Sunday) between 9 A. M. and 8 P. M.

### CHICAGO (Downtown)

*Address:* 737 North Michigan Avenue
*Location:* 5th Floor
*Telephone:* Superior 3214

### CHICAGO (North Side)

*Address:* 4450 Ravenswood
*Location:* Corner of Sunnyside and Ravenswood West
*Telephone:* Longbeach 5172

### NEW YORK

*Address:* 630 Fifth Avenue (Rockefeller Center)
*Location:* 33rd Floor of International Building
*Telephone:* Circle 7-0574

### LOS ANGELES

*Address:* 115 North Robertson Boulevard
*Location:* 1½ blocks North of Third, ½ block South of Beverly
*Telephone:* Bradshaw 23448 (Los Angeles)
Crestview 19158 (Beverly Hills)

### DETROIT

*Address:* 2648 West Grand Boulevard
*Location:* 2nd Floor
*Telephone:* Madison 8831

### BUFFALO

*Address:* 3041 Bailey Avenue
*Location:* 2nd Floor
*Telephone:* Parkside 1489

INTERIOR VIEW LOS ANGELES STUDIO

# life... visit these Scott studios

These salons differ from the ordinary radio display rooms as much as a Scott differs from the average production-line product. Instead of various cabinets being grouped side-by-side around the walls of a store, they are arranged in different rooms which closely duplicate those of fine homes. *The value of such a plan is that it enables you to hear a Scott under virtually the same acoustic conditions found in your own home.* A few photographs of our Studio interiors will be found on this page.

When you visit us you will see and hear—with an actual demonstration—just how a Scott differs from any other instrument of its kind ever built. No obligation is involved, of course.

Scott receivers are built to order in very limited numbers and are not sold in dealer stores, but direct from my Laboratory to you. In this way you save the usual dealer's profit which often amounts to as much as 40% of the retail selling price. The Scott studios shown are all *direct branches* of our own. Every Scott is built at the Chicago Laboratories in Chicago under my personal supervision and complete facilities are maintained for installing and servicing Scott receivers at each of our branches. In each studio you will find expert technicians, trained at our Laboratories in Chicago, who will be glad to consult with you about your radio problems.

E H Scott

INTERIOR VIEW CHICAGO STUDIO

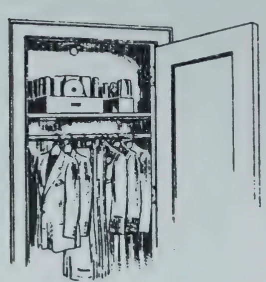
INTERIOR VIEW CHICAGO STUDIO
INTERIOR VIEW DETROIT STUDIO (Below)

INTERIOR VIEW BUFFALO STUDIO

addition to the automatic phonograph record changer, recording equipment was provided in this installation. The basic Quaranta did not include recording equipment, which in those days involved the cutting of a record disc. Tape recording had not yet become available for home use at that time. Of course, recordings of radio programs could be made directly from the audio output provided for them, but to make possible high quality recordings of local events, a high grade ribbon microphone of broadcast quality was installed. However, sometimes it was used to pick up local talent in one room so that it could be listened to on the speaker system in another room without recording.

Later as other receiver designs were completed, Scott often provided combinations of other tuners and amplifiers for custom installations in homes, hotels, restaurants, boats and other locations. Sometimes special cabinets housed the equipment and in other cases parts of the installation would be located in closets or behind walls.

Receiver in Basement Remotely Controlled from Living Room



Remotely Controlled Receiver Installed in Clothes Closet

Built-in Speaker Above Fireplace with Remotely Controlled Receiver

## The Scott Philharmonic

In the Philharmonic, Scott strove to create the finest high fidelity custom built receiver possible at that time. Also, many additional features beneficial to short wave reception, phonograph record reproduction, and general listening were included. Several of the main features had been incorporated and tested in the Full Range ALLWAVE 23. The volume range expander, which was used as a separate unit with the Full Range ALLWAVE 23, was built into the Philharmonic. The record scratch suppressor was built into the Philharmonic as a new development. The operation of both of these features will be discussed in more detail below. The Philharmonic had seven additional tubes as compared with the Full Range ALLWAVE 23. Comparatively, the following tube additions and deletions were made:

| Additions | Deletions |
|---|---|
| 1-RF stage | 1-Beat Frequency Oscillator |
| 1-IF AGC | 1-Tuning Meter Amplifier |
| 1-Tuning Indicator Tube | 1-Audio Amplifier |
| 2-Record Scratch Suppressor | |
| 5-Volume Expander | |

The AM Philharmonic covered the range of 150 kHz to 80 MHz (long waves, AM broadcast band, police and short waves) in six bands as follows:

**Long Waves-150 to 400 kHz**
**Broadcast Band-550 to 1600 kHz**
**Police Band-1.6 to 4.0 MHz**
**Short Wave #1-4.0 to 10.0 MHz**
**Short Wave #2-10.0 to 24.0 MHz**
**Ultra High Band-24.0 to 80.0 MHz.**

The antenna input circuit was arranged so that a switch connected the antenna as a regular L-type to the primaries of the long wave, broadcast, police and Ultra High band and as a doublet when on Short Wave bands 1 and 2. When on the Ultra High band the signal was fed into its own RF circuit and the regular antenna and RF stage were not in the circuit. On the short wave bands 1 and 2, the signal from the antenna was fed through the Super Shield Coupling system, invented by Murray Clay. On the other bands, the signal was fed through conventional coupling.

Variable selectivity was realized by providing six of the double tuned i.f. circuits with small variable condensers which, operating in opposite directions as the fidelity control knob was turned, served to vary the bandwidth as required. The problem with this type of variable selectivity was that it caused the sensitivity of the i.f. amplifiers to drop as the bandwidth was widened. This situation was corrected by ganging a variable resistor to the fidelity control to regulate the bias on the i.f, amplifier tubes keeping the sensitivity nearly constant as the fidelity was varied. Two additional switches were ganged to the variable selectivity control to refine its operation as a fidelity control. They included a control switch which cut the audio response beyond the point where the selectivity curve began to attenuate. Such a control was useful to reduce the noise further on phonograph record programs broadcast by radio stations and on some short wave reception. Also another switch connected a 0.15 mfd. condenser across a smaller value of capacity in the primary of the r.f. tuned circuit to broaden this circuit for higher fidelity when the i.f. system was broadened to a certain point.

Two separate automatic gain control systems were employed in the Philharmonic. The first controlled the r.f. amplifiers and the second controlled the i.f. amplifiers. In the r.f. AGC circuit, the i.f. and signal frequency were amplified, rectified and applied as control on the 1st r.f. tube on all bands. This arrangement prevented overload in the r.f. and converter tubes thereby eliminating noise and distortion when tuned to a powerful local station, or adjacent channel "slop over" from locals, when tuned to a distant station. For the i.f. AGC, output from the 2nd i.f. plate circuit was rectified and applied as control on the first three i.f. stages. It was proportioned so that practically constant signal level was maintained at all times. This system gave satisfactory tuning indication even when operating under high fidelity conditions.

Due to the efficient AGC circuit of the Philharmonic, when tuning between stations the full sensitivity of the receiver would open up and interstation noise would be heard if the location was not a "quiet" one. However, with the variable sensitivity control the sensitivity could be set to any predetermined level and the AGC voltage could be "throttled" so that it would not drop below a set level. Thus, quiet interstation tuning could be realized when the control was set for the noise level at a given location. This action was accomplished in one-half of a dual diode tube. The other half of this tube was used in a peak noise limiter circuit to reduce noise of that type.

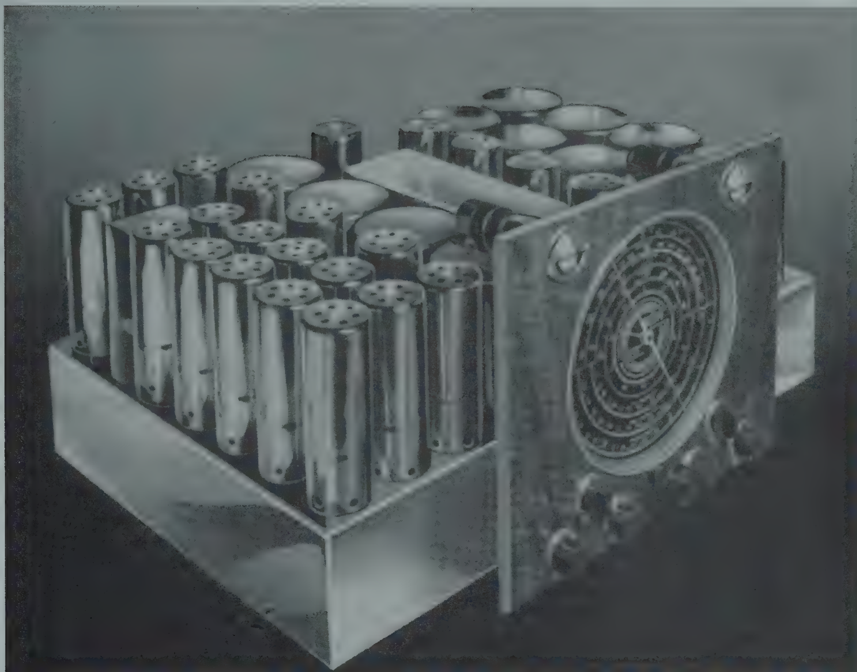
The record scratch suppressor operated like an

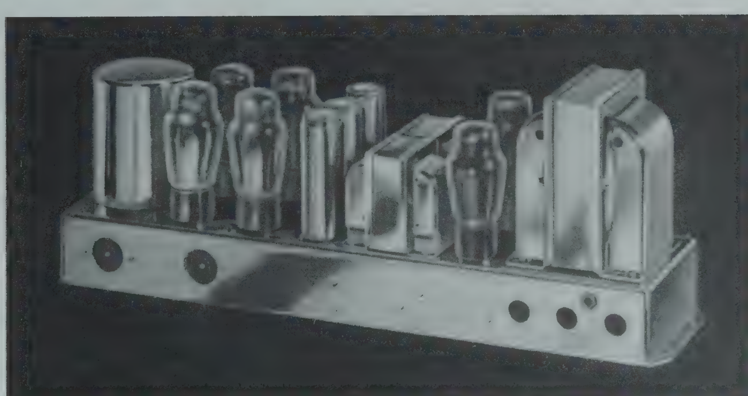
automatic tone control. A tube functioning as an amplifier and rectifier was connected to the input of the main audio circuit through a 100 mmfd. condenser. Rectified voltage was supplied to another tube, whose gain was a function of the applied bias. This second tube caused an effect upon the input to the first audio stage as though a variable condenser was shunting it. This "condenser" effect at any instant was determined by the signal acting on the grid of the first tube mentioned above. Any signal above 1500 cycles, which placed 30 volts or more on the grid of the second tube, would cause it to be "cut off" and no high frequencies would be affected. However, lower level signals in the scratch frequency range would cause the "condenser shunting" effect and thereby eliminate undesirable needle scratch noise at low volume, but with no effect on the full reproduction of the higher frequencies at normal or high volume.

Volume expansion as applied in the Scott Philharmonic was provided by utilizing the characteristics of a tube type 6L7. In addition to its heater, cathode and plate, this tube had five grids. Two of three grids were control grids-one with a remote characteristic and one with a sharp cutoff characteristic. Of the three remaining grids-two were screen grids and one was a suppressor grid. In operation, the signal to be expanded was fed to the remote cutoff grid of the 6L7 and also the input of a control amplifier followed by a rectifier. The output of this rectifier was applied to the sharp cutoff grid of the 6L7. When an audio signal was applied and the rectified voltage fed to the sharp cutoff grid, the transconductance and gain of the 6L7 were increased. This increase in gain was approximately proportional to the rectified diode voltage and, hence, to the signal amplitude. Thus, the gain relative to the input signal on the remote cutoff grid was increased and the volume was expanded. The circuit in the Philharmonic differed from the basic circuit described above only in that 6L7 tubes were used in push-pull. The operation was the same. In the Philharmonic, five tubes were used in the expander system. Two of them were the 6L7s, one was a driver amplifier, the fourth was a diode to supply the rectified control voltage referred to above and the fifth was the so-called magic eye indicator tube to show the degree of expansion. The expander enabled the volume at the receiver to be restored to the original volume range of the program prior to its compression by the recording engineer in the case of records or by the monitoring engineer at the broadcast station.

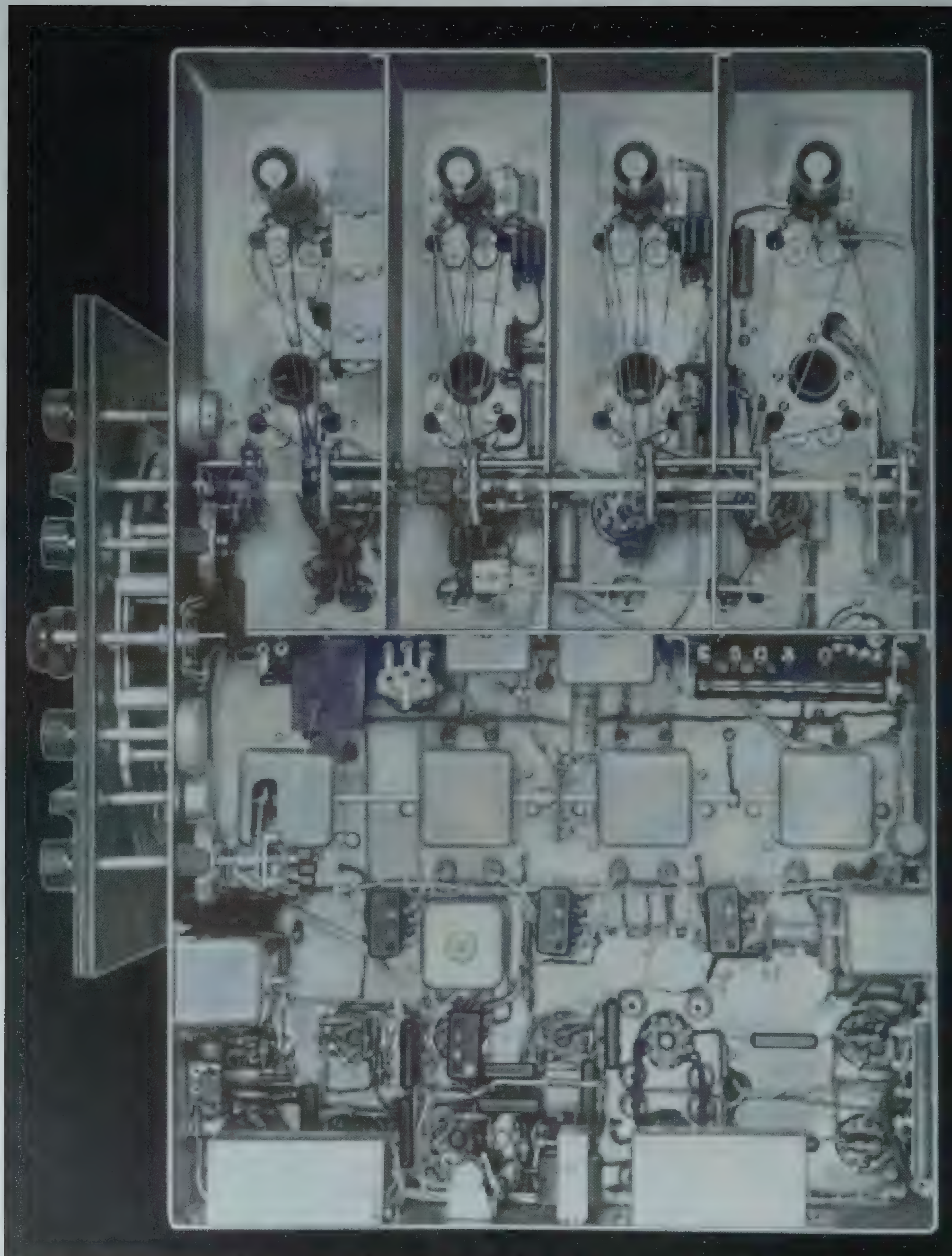
In the audio amplifier of the Philharmonic, four stages were employed to give adequate gain and more than 40 watts of output with less than 1% harmonic distortion. There was actually a fifth stage in the audio chain. However, this consisted of 6L7s in the volume expander described above. To provide for bass compensation at low volume levels, the volume control at the input of the amplifier was tapped at an appropriate point above the ground end and shunted there by a capacitor and resistor in series. A special 10,000 cycle attenuator network was connected in the plate circuit of the first audio tube. It consisted of a variable resistance, two fixed condensers and an inductance with a movable core. This combination provided for a high degree of attenuation of the undesired 10,000 cycle adjacent channel whistle without affecting frequencies below 8500 cycles or above 11,000 cycles. The output stage of an inverter fed into the control grids of the push-pull 6L7 expander tubes, which although primarily for the purpose of expansion also served as a coupling stage between the 2nd and 3rd audio stages. A dual bass enhancement circuit was connected in a plate circuit of the 6L7 tubes. It consisted of two 175 henry inductances tuned by a.02 mfd. condenser in shunt. Bass control was accomplished by means of a dual potentiometer. Its one megohm section was across the inductances and its 10,000 ohm section was connected back to the inverter grid input through a 100,000 ohm resistor. This system provided a wide degree of bass variation and gave high bass boost peaks at 45 and 70 cycles. A decided dip in response at 60 cycles and a rapid fall off at 120 cycles served to reduce 60 cycle power line hum and station hum that was sometimes present in the broadcasts.

When the Philharmonic was first introduced it used a 15" single curvilinear cone speaker with some center design to diffuse the high frequencies. Provision was made for connecting a separate speaker as well. Later, especially when the FM-AM Philharmonic appeared, a speaker system consisting of a 15" cone to handle the range of 30 to 2000 cycles and two 5" high frequency reproducers to handle the range of 2000 to 15,000 cycles were used. These speakers were fed by a dividing network with a crossover frequency of 2000 cycles.





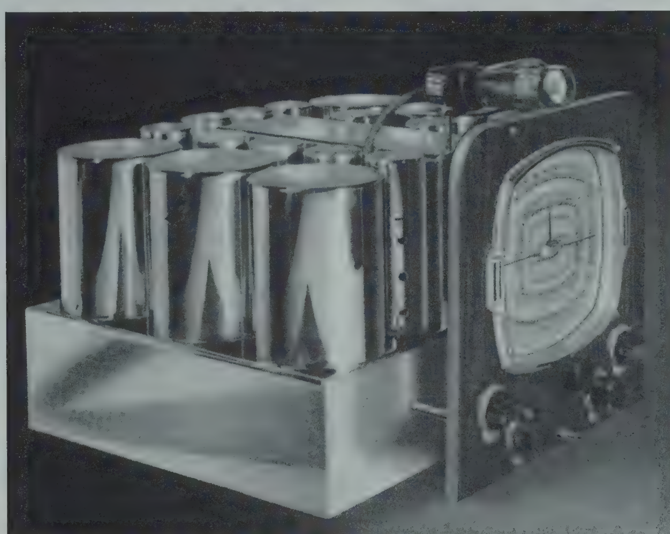
30 Tube Philharmonic Comprised Of
24 Tube Receiver Chassis (Top) And 6 Tube Power Supply/Audio Amplifier (Bottom)

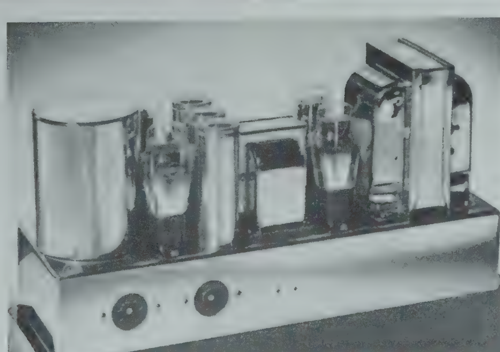


Bottom View of Philharmonic
24 Tube Receiver Chassis

## The Scott Sixteen and Eighteen

Although the Philharmonic represented the peak in a multi-faceted receiver, Scott felt that he could not rely on one model to provide enough business to keep the company in a satisfactory financial condition. So, he widened his product line later in 1937 after the announcement of the Philharmonic by introducing two lower priced models, the Scott Sixteen and the Scott Eighteen. Although these receivers were new designs, their features were somewhat less than those of the Philharmonic. The latter was literally a storehouse of features and lesser models were based largely on how many features could be omitted from a receiver and still have a good workable unit. The Scott Eighteen had twelve less tubes than the Philharmonic, which was achieved by eliminating one r.f. stage, one i.f. stage, the volume expander system, the noise silencer, a voltage regulator, and by using a tube which combined the 3rd i.f., 2nd detector and the i.f. AGC thereby eliminating a tube which supplied only the i.f. AGC in the Philharmonic. The Scott Sixteen omitted the record noise scratch suppressor, which eliminated two more tubes. Both the Eighteen and the Sixteen used a much less expensive variable selectivity arrangement than that of the Philharmonic. To give two selectivity positions (sharp and broad) fixed condensers were switched to change the tuning. A bias correction was required as with the Philharmonic to maintain constant i.f. gain as the bandpass was varied.





**Scott Model Sixteen Receiver Chassis (Top)**
**And Mating Power Supply/Audio Amplifier (Bottom)**

## The Phantom

About mid-1938, Scott introduced the Phantom model, which had a tube complement very similar to that of the Eighteen model mentioned above. It was either a 19 or a 20 tube receiver depending upon whether a voltage regulator was used on its B+ line. Above the Eighteen, it had a noise silencer and a newly developed variable selectivity system, in which the coupling between the i.f. transformers in the first and second i.f. stages was varied to provide sharp, medium, and broad positions. The Eighteen and Sixteen models never received the publicity which they probably deserved because the advertising for the Philharmonic completely overshadowed them. By the time the Phantom appeared, more than a year had passed since the introduction of the Philharmonic, so it had a better chance to get its share of attention. Scott heralded it as a remarkable new receiver which revolutionized short wave and broadcast reception. Although the ads mentioned its tonal realism, they devoted more space to its performance as a short wave and long-distance broadcast receiver. Its noise limiter, which was the Dickert type used in amateur communications receivers, and the supershield antenna coupling system, which functioned only in the short wave bands, emphasized its value as a DX receiver.

Since the Phantom was the prime model for 1938, the product line could only be broadened to its lower limits by considering how many features of the Phantom could be eliminated and still have a practical and workable receiver which portrayed Scott quality. Such a receiver was provided in the Scott Super XII (Twelve). When one is thinking and talking in terms of 20 and 30 tube receivers, 12 tubes do not sound like many. However, it has to be remembered that Scott set his many short wave listening records on the ALLWAVE 12 and the ALLWAVE 12 DELUXE. With eight tubes less than the Phantom, the Super XII deleted the needle scratch suppressor and the separate RF Automatic Gain Control (the r.f. and i.f. amplifiers derived their AVC voltage from the same source-the 2nd detector). Two tubes were eliminated from the audio amplifier partially through the combination of functions. The peak noise limiter was eliminated and one power rectifier was dispensed with by using an audio output stage with less power output than that of the Phantom.

In 1939, after Scott had bought and assimilated the assets of McMurdo Silver, Inc., he thought that he should keep that line alive at least faintly if not otherwise. So he introduced the Scott Masterpiece which was a 14 tube receiver, with two more tubes in the audio system as compared with the Scott Super XII. The latter was rated as having undistorted Class A power output of 9 watts, while the Masterpiece was rated as having comparable power output of 15 watts. Scott compared the Masterpiece with the Phantom Deluxe and the Philharmonic in the following way. In his view, the Masterpiece was an ideal instrument for those who desired a much finer receiver than the average mass production radio. The Phantom Deluxe was designed for the music lover and radio listener who desired unequaled record reproduction, increased fidelity, and comparatively noise-free distance reception. The Philharmonic was for the discriminating taste of those who were satisfied only with the best instrument Scott could build regardless of cost and that a finer all-purpose receiver and record reproducing medium could not be built for several times its nominal cost.

To support and confirm the reputation of tonal excellence held by Scott receivers many well-known musicians, orchestra leaders and other notables had acquired Scott receivers and attested to their excellent performance in musical reproduction. These included Jascha Heifetz and Yehudi Menuhin, the internationally known violinists; Deems Taylor, music consultant of the Columbia Broadcasting System; Eugene Ormandy, Conductor of the Philadelphia Symphony Orchestra, Frederick Stock, Conductor of the Chicago Symphony Orchestra; John Barbirolli, Conductor of the New York Philharmonic Symphony Orchestra; Eugene Goosens, Conductor of the Cincinnati Symphony Orchestra; Fritz Reiner, Conductor of the Pittsburgh Symphony Orchestra; Arthur Rodzinski, Conductor of the Cleveland Symphony Orchestra; Vladimir Horowitz and Jose Iturbi, internationally famous pianists; Harl MacDonald, noted composer and Musical Director of the University of Pennsylvania; Kirsten Flagstad, the famous Wagnerian soprano; Richard Crooks, internationally known tenor; Ezio Pinza, distinguished basso; Elizabeth Rethberg, noted operatic soprano; Lawrence Tibbett, world famous baritone, and many other leaders in the musical world.

Further along this line, Scott began to sponsor a full hour of the world's finest recorded music over station WCFL, one of Chicago's best high fidelity stations. This program was sponsored, toward the end of 1939, with 59 minutes of music and one minute of commercial advertising. It was broadcast every night from 10:30 to 11:30 p.m. except on Sunday.

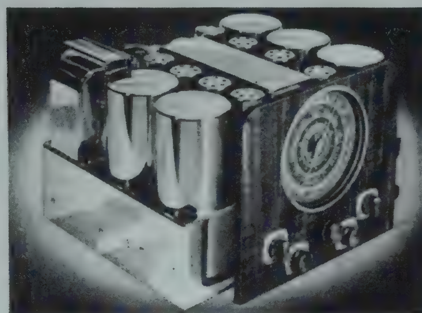
As Scott entered 1940, he reviewed 1939 as one of the best years in the history of his company and stated that he considered the Philharmonic, the Phantom Deluxe and the Masterpiece receivers to be the best receivers that he had ever built and that he believed sincerely that they were the finest radio receiving instruments.

# *The New* SCOTT SUPER XII CHASSIS PRICED AS LOW AS

## $99^{\underline{50}}$ PLUS TAX AT CHICAGO

★

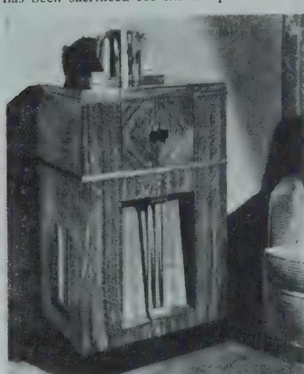
**A SUPER EFFICIENT CUSTOM BUILT GENUINE SCOTT TWELVE TUBE RECEIVER**



The insistent demand from thousands who have wanted a smaller, more compact, and less costly Scott custom-built receiver, has resulted in the design of the new Super XII, It will fit into nine out of ten standard consoles . . . the ideal chassis for those owning an obsolete receiver but who hesitate to part with a fine cabinet. Although it has been priced without a console, a selection of fine, acoustically built Scott cabinets are offered at a range of prices to suit your budget.

### BUILT FROM THE SAME FINE PARTS

In designing the Scott Super XII nothing has been sacrificed for the compact size. It is custom-built by hand with fine watch precision by the same skilled technicians who have been building Scott Receivers for years, and from the same high quality parts. The same FIVE YEAR GUARANTEE accompanies this receiver as is given with a Scott costing several thousand dollars more.



SCOUT SUPER XII IN NEW ACOUSTICRAFT CONSOLE

### A TRUE HIGH FIDELITY RECEIVER

Magnificent tonal realism . . . the feature that distinguishes all Scott Receivers, is more outstanding than ever in the new Super XII. The tone is just as perfect as in the Scott instruments built for such outstanding figures in the musical world as Toscanini, Melchoir, Goosens, Papi and many others. It reproduces all frequencies from 30 to 8500 cycles.

### EXTREMELY SELECTIVE & SENSITIVE

The Scott Super XII is provided with a control that gives *two* degrees of selectivity . . . one razor-sharp for distant reception, the other broad for high fidelity reproduction. This makes it the ideal receiver for the DX enthusiast as well as the lover of fine music who demands finest possible tone quality. Variable sensitivity is so great, even finest laboratory testing equipment can hardly measure the EXTREMELY WEAK transmissions tuned in and amplified with this amazing new receiver.

### 30 DAY HOME TRIAL IN U. S. A.

Test the magnificent performance of the new Scott Super XII in your own home. If it does not bring in distant stations on short wave or broadcast bands with more volume and less noise and interference than any other receiver, you can return it for refund. NOT SOLD THRU STORES. Send the coupon for all the facts and special offer.

THE STRADIVARIUS OF RADIO RECEIVERS SCOTT

**E. H. SCOTT RADIO LABORATORIES, INC.**
4440 Ravenswood Ave., Dept. 5W8, Chicago, Ill.
*Please send all facts and special offer on the new Scott Super XII.*

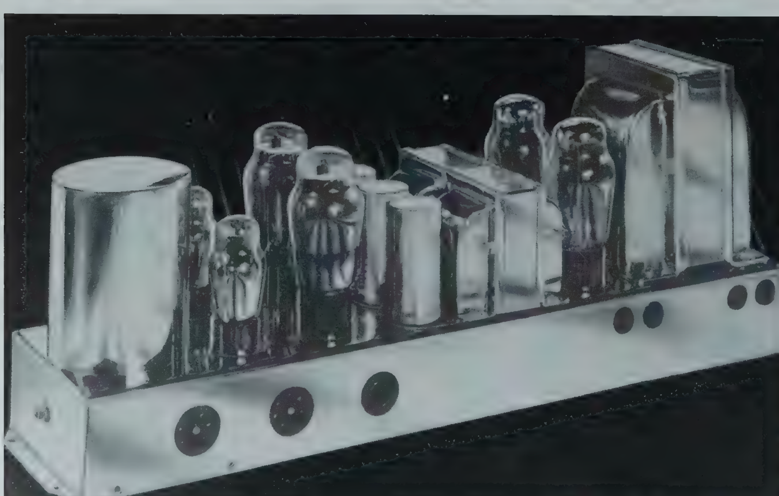
*Name* ..................................................

*Street* ..................................................

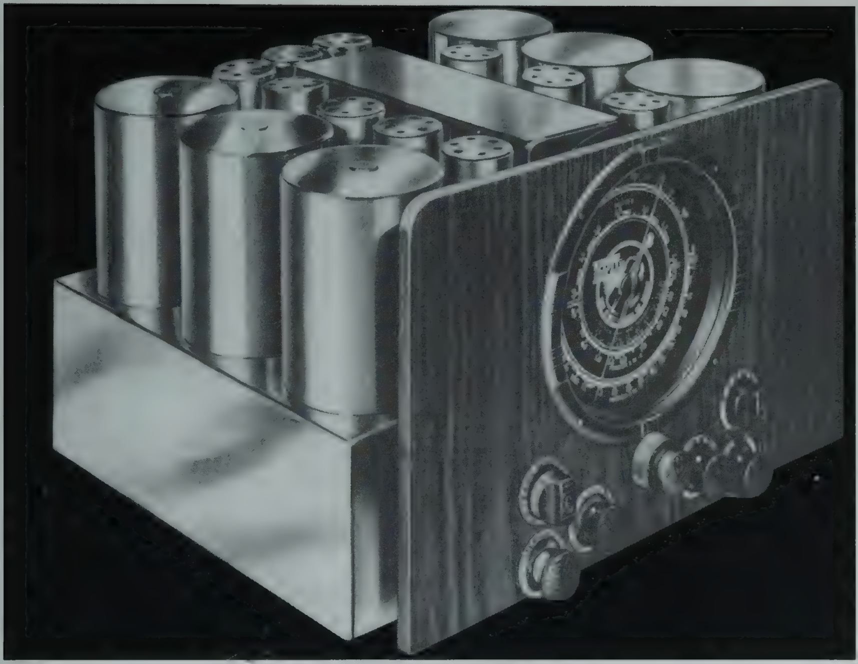
*City* .............................. *State* ..............

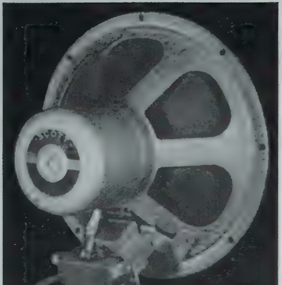
Studios: New York . Detroit . Buffalo . Chicago . Los Angeles

(Radio News - December, 1938)

**Phantom Deluxe Receiver Chassis (Top)**
**Phantom Power Supply/Audio Amplifier And Mating Speaker (Bottom)**





**Masterpiece Receiver Chassis (Top)**
**Masterpiece Power Supply/Audio Amplifier And Mating Speaker (Bottom)**

Arturo Toscanini
*Conductor*
NBC Symphony Orchestra

In 1927 Arturo Toscanini was appointed regular conductor of the New York Philharmonic Orchestra. In 1937 came his appointment as conductor of the National Broadcasting Company's Symphony Orchestra whose brilliant performances have thrilled millions. Arturo Toscanini is today one of the most distinguished and best loved conductors in the world.

CABLE ADDRESS: PHILHARMON

TELEPHONE: CIRCLE 7-4733

THE PHILHARMONIC-SYMPHONY SOCIETY OF NEW YORK

FOUNDED 1842

STEINWAY BUILDING, 113 WEST FIFTY-SEVENTH STREET

March 30, 1934.

Mr. E. H. Scott,
4450 Ravenswood Avenue,
Chicago, Ill.

Dear Mr. Scott:

Last year I had the pleasure of listening to one of your receivers in the home of my friend, Mr. Campanari, in Genova and could not help noticing the superb tone of his instrument.

Since installing your latest instrument in my suite here at the Hotel Astor, I would like you to know I have had many hours of pleasure from it. Never would I have believed that it was possible to attain such a marvelous reproduction and to you assuredly belongs the credit of having produced a miracle of perfection. What satisfies me really very much is the quality of the tone which is mellow, clear, beautiful and not confused as in other receivers which I have had before yours.

Wishing you the success which you deserve, I am

Yours very truly,

Arturo Toscanini

# Chapter 9

# The Company Looks In New Directions

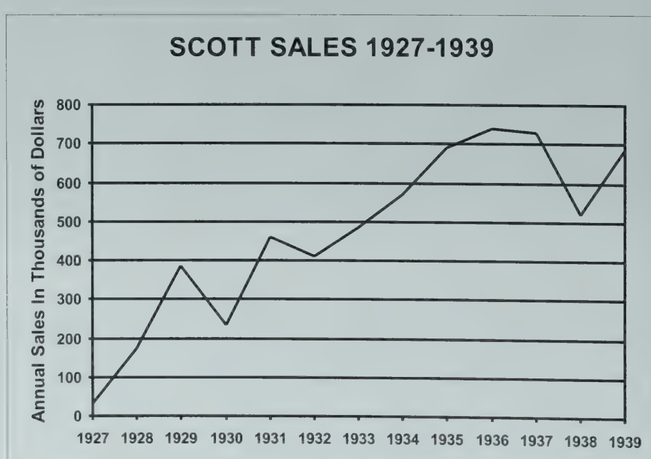
As the Scott Transformer Company, annual sales grew from $32,000 in 1927 to $235,083 in 1930. The company's name was changed to E.H. Scott Radio Laboratories in 1931. As shown below, the company sales rose steadily to $730,000 in 1937. In 1938, they fell to $520,000. Mr. Scott attributed this decline to a lack of advertising during the first quarter of 1938. However, I have not seen that he ever gave any explanation for why he did not advertise.

## British Ozaphone

Although sales rebounded a bit to $685,000 in 1939, the company experienced considerable financial difficulties during that year. A source from inside the company, who had left prior to 1939, claimed that this situation had developed due to Mr. Scott's investment in a company known as British Ozaphone, Ltd. of London, England. He had wished to tap the British market and had licensed this company to produce versions of Scott receivers. They could not just produce copies of the American sets, because electrical power was at 220 volts, 50 cycles. Also a long wave band and the intermediate frequency changed as well. In early 1938, they built a version of the Scott Sixteen receiver with these modifications. Toward the end of 1938, they built a version of the Phantom with similar changes. It is not clear whether any significant quantity of either receiver was produced.

In addition to producing receivers under a Scott license, British Ozaphone was engaged in the development of a sound recording system known as the "noiseless" or silent recording type. When one considers the amount of noise that emanated from Shellac records of the period, it is not surprising that Mr. Scott would be interested in it. In a U.S. patent filed in Great Britain on July 2, 1936, E.J. Wender of the Ozaphone Company describes the system in detail.

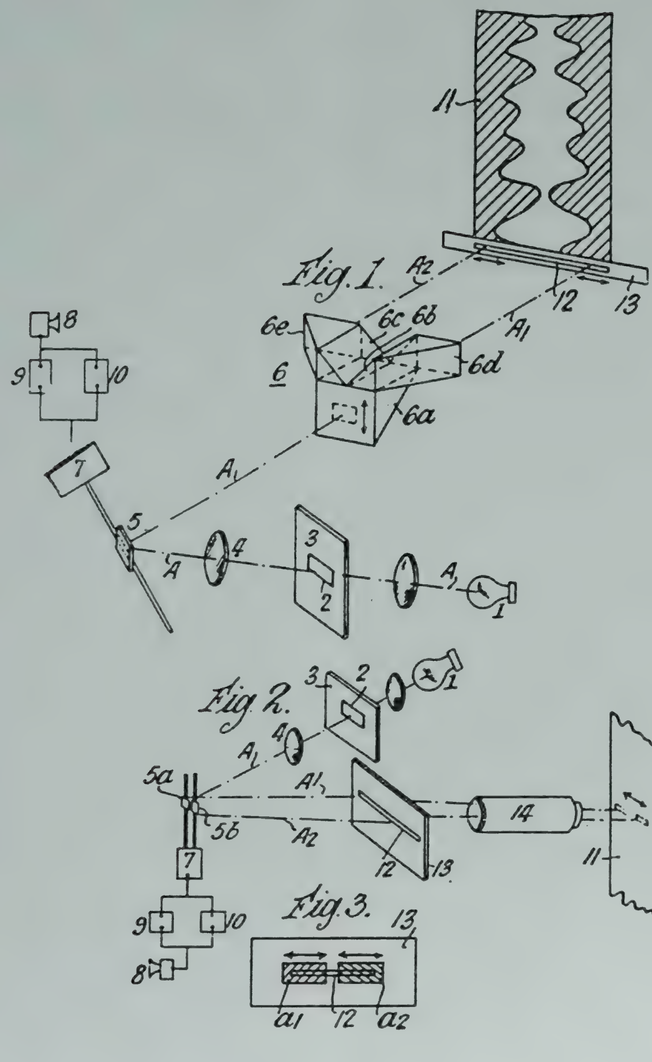
According to Wender's patent, his invention covered a method of producing variable area sound recording on film, projecting upon it a pair of light strips extending in the same straight line and in a direction at right angles to the direction of motion of the film. The inner edges of the strips extended parallel to the direction of motion of the film and were spaced apart to constitute two recording edges. These strips moved similarly and simultaneously toward or away from one another in accordance with the sound to be recorded and in accordance also with the main strength or envelope of the sound to be recorded.



Feb. 14, 1939. E. J. WENDER 2,147,623

SOUND FILM RECORDING SYSTEM

Filed June 26, 1937




Inventor:
Eugene John Wender
by: Baldwin & Wight, attys

Wender described Figures 1, 2 and 3 of the patent as follows:

*Referring to Fig. 1 light from a source represented by a filament 1 is projected through a rectangular or other parallel sided aperture 2 in a mask 3 and thence via a lens system 4 on to the moving mirror 5 of an oscillograph represented in part by the rectangle 7 whence the said light is reflected to a composite prism arrangement 6 or its equivalent, which divides the light beam into two, the prism arrangment being such that when movement of the light beam occurs due to actuation of the oscillograph the separated or divided light beams more equally in opposite directions. As shown the prism arrangement consists in effect of five totally reflecting prisms united together, the five totally reflecting faces being marked 6a,6b, 6c, 6d and 6e. The light beams are represented by their centre lines (as shown as chain lines) and it will be seen that the original single beam A Is divided by the arrangement 6 into two, A1 and A2. The oscillograph Is energised in accordance with sound signals to be recorded and also in accordance with the envelope wave of such sound signals. For example sounds picked up by a microphone 8 are converted into sound signals and, after amplification by an amplifier 9 fed to the oscillograph 7-5 to which is also fed a sound envelope wave obtained as known per se by a signal fed rectifier arrangement at 10. The apparatus 7, 8, 9, 10 is shown purely schematically as it is well known per se. The separated light beams A1 A2 are projected upon the film 11 through a narrow slit 12 in a mask 13 so that there is produced upon the film two narrow strips of light spaced a short distance apart and in the same straight line running transversely with respect to the direction of motion of the film. The innermost ends of these strips of light constitute the "cutting" or "recording" edges and the said innermost ends will approach one another or recede from one another in dependence both upon the sound and upon the sound envelope. The movements due to the sound and the sound envelope are represented by double headed arrows and the dotted rectangle shown on the prism arrangement represents an image of the aperture.*

*2. The type of record obtained is conventionally indicated on the film.*

*In another modification of the invention represented schematically in Fig. 2 a double oscillograph, i.e. an oscillograph with two mirrors and two movements or two separate oscillographs is or are employed and a beam of light A is projected through a rectangular or other parallel sided aperture 2 in a mask 3 on to the two mirrors. In the figure a double oscillograph 7—5a-5b is represented, the two mirrors being represented by 5a and 5b. The oscillograph movements are so connected and energised from 9 and 10 that they move in opposite direction when energised by the same sound and sound envelope currents. If desired, and by means of any known electric filter means (not shown) in the energising circuits for the oscillograph movements each oscillograph movement may be made responsive only to a predetermined frequency range within the whole acoustic range to be handled, one oscillograph being responsive to one frequency range (a higher range) and the other oscillograph being responsive to another (a lower frequency range). The oscillograph movements are energised in dependence upon the sound wave to be recorded and also in dependence upon the envelope or average strength of said sound wave and the beams A1 A2 of light from the mirrors are projected via a slit 12 in a mask 13 and thence via an optical system 14 upon the film 11 so as to produce upon the said film two strips of light (represented by the broken line rectangles on the film) which move as in the embodiment of Fig. 1 i.e. as indicated by the double headed arrow. The actual recording Is not represented on the film 11 shown in Fig. 2. The two oscIllograph movements are both responsive to the whole frequency range and the record obtained will be of the nature shown on the film 11 in Fig. 1. That is to say the sound track recorded consists of a central unexposed portion (shown white in Figure 1) between recorded portions (shown shaded). In Figure 3 the mask 13 with the slot 12 is shown and on it is represented, by means of shaded areas a 1 and a2, the acoustically vibrated light images obtained on the mask, part of the light in which proceeds through the slot 12 on to the film to perform the actual recording. For the sake of clarity these shaded areas are shaded in opposite directions. In Figure 3 the two areas al, a2 vibrate oppositely as indicated by the arrows, the inner edges, which constitute the cutting edges never quite meeting and the outer edges never coming inward of the outer edges of the slot 12.*

Another inventor, James R. Balsley, filed for a patent in 1935 titled "Sound Reproduction" which increased volume range without complicated electrical circuits. He stated that this is accomplished by projecting a sound translating beam of light varying in accordance with the average volume of the recorded sound as described in the patent application. On low levels of sound, the intensity of the translating beam is decreased causing a lower level sound to be reoproduced which is not proportional to the sound level on the record. On reproducing from a normal type of biased sound track, the reproduced volume range will be greater than the volume range recorded upon the film. Therefore, an expansion or a greater contrast will be produced between the various reproduced sound levels this creating a pleasing and dramatic effect. This patent, #2,144,749, was granted on January 24, 1939, and assigned to United Reproduction Company.

James Balsley described Figures 1, 2 and 3 (see next page) of this patent as follows:

*Fig. 1 is a diagrammatic view of a sound reproducing system embodying the invention. Fig. 2 is an enlarged fragmentary view of a variable area type of fllm which is adapted to be used in the system illustrated in Fig. 1.*

*Fig. 3 is an enlarged fragmentary view of a variable density type of film adapted to be used in the system illustrated in Fig. 1.*

*Referring to Fig. 1, the film 1 may have either a variable area or a variable density soundtrack thereon of the noise reduction type wherein the sound wave representations are biased or shuttered. However any type of record may be employed in which the average amount of opacity at any particular point along the sound track is substantially proportional to the average volume of the latent sound on the film at that particular point. Light from an exciter lamp 3 is passed through a condenser lens 4 and a mask 5 to pass a beam of light 2, rectangular in cross section, (Fig. 2) through the sound track portion of film 1. Although the beam 2 is shown and described as being rectangular in cross section, it is to be understood that various other cross sectional shapes may be employed if desired. The light thus passed through the film 1 is reflected on the opposite side by mirrors 7 and 8 into lenses 16 and 17 or a slit assembly 9 from whence it is focused as a sharp line of light on the film at the point of sound translation F, preferably in the center of the beam 2. The emerging translating beam of light as modulated by the sound track portlon of film 1 passes into a photo-electric cell 18. Electrical impulses corresponding to the modulated light beam thrown upon the photo-electric cell 10 are passed through amplifier 11 and thence into the loud speaker 12.*

*When variable area type of sound records are employed, a cylindrical lens 18 may, if desired, be Inserted in the beam of light between the lens 17 and the film 1 so as to image the spherical lens 17 upon the film. The addition of this lens 18 produces on the film 1 a slit of light having an intensity which is uniform along the length of the slit but which varies in direct proportion to the amount of light passing through the slit 9. When employing a variable density type of sound record the lens 18 may, if desired, be allowed to remain in the path of the translating beam.*

*Preferably, the height of the beam 2 as indicated by the dimension H (Figs. 1, 2 and 3) is such that it includes several sound wave cycle representations on film 1; at least it should be sufficient to cover one cycle representation at the lowest frequency to be recorded. It will therefore be seen that the beam 2 upon emerging from the film 1 will have an intensity which varies substantially in accordance with the envelope of the sound wave representations passing across the point F. This beam as reflected and focused at the point F upon the sound track will therefore produce a fine line or slit of sound translating light L (Figs. 2 and 3) which varies in accordance with the average transmission of the film passing across this line L. In using a biased or other noiseless type of sound track, this average transmission, of course, will depend on the volume of the sound or, in other words, upon the envelope of the sound waves at any particular point along the length of the film. When sounds of low intensity pass the beam of light L the average print transmission will be low. Therefore, the sound reproduced by the low level portions of the sound track as at 13 and 14 will be further decreased due to the decrease in intensity of the line of light L. This not only allows the low level sound limit to be additionally lowered but it also decreases the ground noise, due to the film, a corresponding amount. When high level sounds are being reproduced, as at the point 15, the average transmission will be at its highest value and therefore the light beam L will have its highest intensity allowing for full amplitude of current to be set up by the photo-electric cell 10.*

*The fact is that the arrangement, shown in Fig. 1 provides means for multiplying the effective noise reduction in reproducing sound from the film 1 for the*

Jan. 24, 1939. J. R. BALSLEY 2,144,749

SOUND REPRODUCTION

Filed Oct. 29, 1935

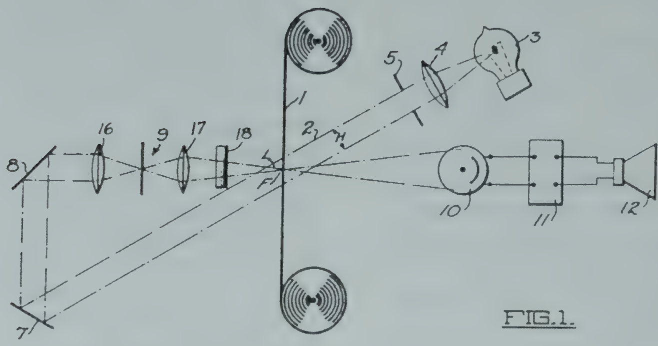



FIG. 1.

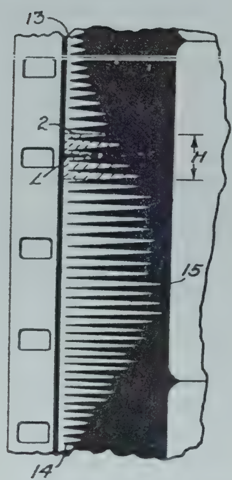



FIG. 2.

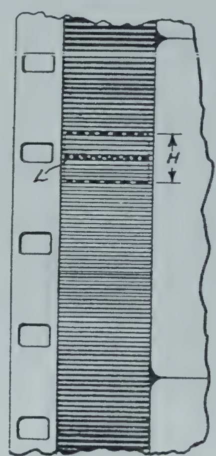



FIG. 3.

INVENTOR.
JAMES R. BALSLEY
BY W. E. Beatty
ATTORNEY

*following reason. Assume that the film 1 has 10 db. noise reduction and therefore an average transmission which varies 3 to 1. In the reproducing arrangements according to the prior art, the average light for translating a noise reduction record such as film 1 would in the assumed case also vary as 3 to 1. In the case of Fig. 1, however, the average light for translating the record varies as the product of the film transmission variation and the translation light variation, each of which is 3 to 1, the product being 9 to 1 or 20 db. effective noise reduction. The noise reduction is therefore multiplied.*

*Upon reproducing from the normal type of noiseless sound record, this system provides a method whereby greater contrast of sounds may be obtained. However, where the so-called compressed type of sound record is used in which the lower volume levels are raised and the upper volume levels attenuated, the invention may be employed to expand the volume range and thus produce a normal reproduction of the sound as originally received in the recording microphone*

*In any event, however, the signal to noise ratio will remain substantially constant, thus preventing the ground noise, due to imperfections in the apparently clear portion of the sound track, from being reproduced.*

By February, 1937, Balsley had joined Ozaphone Corporation of America, where he filed for three patents covering various aspects of such a recording system. All of these patents were granted and assigned to Ozaphone.

Although this type of recording offered the possibility of greatly improved signal-to-noise ratio over disc recordings as well as volume expansion, its development was impeded by World War II. After World War II it was forgotten as magnetic tape recording became the accepted method of replacing disc recording of the period. Recording on magnetic tape originated in Germany before World War II and expanded internationally after the war.

## Despite His Loss Mr. Scott Paints Bright Future

It was assumed that Mr. Scott lost his investment, but the amount was not confirmed. Whatever it was, Mr. Scott was forced to make an agreement in 1938 with the company's creditors as a result of the company's financial condition. Part of the agreement was that he would accept compensation not to exceed $100 per week plus a bonus of 5% of the net profits of the company until all notes to the creditors were paid in full.

Despite this setback, the future for receivers capable of high fidelity reproduction was looking brighter. Frequency Modulation (FM) broadcasting was emerging and the need arose for new receivers to make FM programs available to former and new customers. However, Mr. Scott did not mention this in his report to the creditors. Instead, he mentioned a number of other methods, markets and products which he believed would increase sales as follows:

**NEW TESTED PLAN TO SECURE NEW PROSPECTS AT LOW COST**

**Within the the past six weeks I have conceived a new plan to reach prospects for our receivers which should, on the basis of recent tests, reduce the expense of securing new prospects up to 50%, and will enable me to practically set the sales figures at any amount I desire up to $1,000,000.00 a year or more, according to the amount of working capital I have to handle the business.**

**NEW MARKET FOR HIGH PRICED RECEIVERS**

**Last year I visualized a very large market for our receivers that has been neglected by most radio manufacturers. When people owning very fine homes furnish them they generally employ an interior decorator. These decorators do not care for the usual designs of commercial radio consoles, and prefer very often to design a special cabinet, or build the chassis into some part of the room. I recently had some console designs that were along period lines which have appealed very strongly to the interior decorator trade. I believe I am in an ideal position to capitalize on a very large part of this business as my receivers are not sold in retail stores, and therefore the decorator is not faced with the constant problem of price, and the fact that so many people can get a discount on the ordinary radio receiver. It is a market with very large possibilities that I am particularly well equipped to handle, and that I feel can be made to yield a very large volume of business at a very low sales cost.**

**NEW RECORD CHANGER WITH UNLIMITED SALES POSSIBILITIES**

**A large part of our business at present is record-radio**

phonograph combinations. We have always encountered considerable sales resistance because the only changer we can at present supply plays eight records on one side only. About two years ago I saw an experimental model of a very simple compact record changer that could play not only either 10" or 12" records intermixed, but could play on one side only, or first one side and then the other, that would repeat any record desired, or would reject it. This changer is not only simple, but faster than any other changer that will perform these operations, taking only eleven (11) seconds to change a record as against nineteen (19) seconds with the other changer mentioned.

The tooling up for production of this changer is now practically completed. It is being manufactured by a concern with unlimited capital behind it, and I am one of the two persons in this country, outside the manufacturer, who has actually seen it in operation, and know what it will do. I feel sure it will be possible, <u>provided I can be assured of the working capital I now require</u>, to secure the rights (along with two others) to sell this changer, which I might mention will be sold for less than one-half the price of the only other changer on the market today that plays both sides of a record, and has a mark-up for us of about 300%. <u>The sales possibilities of our receivers, in combination with a record changer that will play both sides of a record is unlimited</u>.

## <u>TELEVISION BOOM DUE THIS FALL THAT OFFERS SPECIAL SALES POSSIBILITIES</u>

Three months ago I believe it was universally thought throughout the radio industry that Television was still in the experimental stage, and two or three years away from being any great value commercially. However, an event took place approximately six weeks ago that has altered the whole Television situation overnight. The event was the televising of a championship boxing match in London. A Television camera was taken into a room with the two boxers and their trainers before the fight, and they were interviewed. During the fight two cameras were trained on the ring, and the complete fight was sent out by Television, and was seen not only on the many thousands of home Television receivers now in use in the London area, but an actual Television picture about 12' square was thrown on the screen of a motion picture theatre, which was crowded to the doors the night of the fight. This was so successful that arrangements have been made this month to televise another championship fight being held in London, and also the start and finish of the Oxford-Cambridge boat race.

There is no question of doubt that if prospects in the United States for a high grade radio can, at the expenditure of another $200.00 or $300.00 secure an instrument by which they have a chance of occasionally seeing a championship boxing match, baseball and football contests, and other sporting events, they will buy that receiver in preference to one without Television. I believe this fact will be generally recognized by the industry in a very few weeks.

I know there has been a great deal of talk, and perhaps I have been guilty of it for obvious reasons, that Television was a long way off, and that it must go thru the same stages of development that the radio industry went thru from about 1919 to 1929. However, once the American radio enthusiast knows it is going to be possible to see such events as the British public are now "looking in" on, <u>Television receivers are going to sell</u>.

I have a large amount of literature which has just been released by British Television manufacturers in my possession, and will be glad to show it to you. I believe you will be astounded when you see the progress that has been made.

Television ictures are now so near perfection to our moving pictures, that the difference in quality is negligible, and the interference problem is, I understand, just about solved by the RCA engineers. Even if it were not, interference has long been a problem in radio reception, and that particular obstacle has never prevented us from selling a large number of radio receivers. In other words, it is merely a factor in sales resistance which is certainly not any greater than some of the other factors of sales resistance that radio manufacturers have had to contend with in the past.

As for Television pictures being too small, I will be glad to show you brochures which will prove that this is another idea that has been blown sky high. At present Television receivers being built in London have a screen 18" wide and 15" high. Certainly this is large enough for even a comparatively large living room.

I believe that the Scott Laboratories will have a tremendous advantage in the Television field as the Television receiver will be comparatively high in price. People expect to pay a high price for a Scott, and I have never had very much trouble in merchandising a high priced instrument, as our market has always been in the upper income bracket where price does not make a great deal of difference.

**As you probably know, the New York Television transmitters of RCA and Columbia will be ready at the end of this month, and a station has been in operation in Los Angeles for over a year. A station in Chicago will be put in operation very shortly. The fact that we have established studios in each of these key cities is now going to prove to a big asset, because it is in these three areas that the sales of Television receivers will be concentrated. At present these areas represent approximately 70% of our sales volume, and a little thought will show the strategic position we now occupy as Television breaks this fall.**

**I believe that you will agree with me there are few manufacturers in the United States who are better equipped to take advantage of the boom there is certainly going to be in Television, as the E.H. Scott Radio Laboratories, Inc.**

**NEW TYPE COMMUNICATIONS RECEIVERS**

**In December I conceived the idea for a new type of communications receiver which I already proved has a very large market, not only among the "ham's", or amateurs, but also among enthusiastic long distance tuners and music lovers. The conception of this new receiver, (on which I expect development to be completed in from 60 to 90 days) is along an entirely different line to the old communications set, and is unlike any other instrument on the market today. I have already tested the market possibilities of this new receiver by a recent mailing to 15,000 prospects in our files, with a letter worded in such a way that prospects would definitely indicate whether or not they were interested in this type of instrument in this price range. The returns indicate that 85% of our prospects are definitely interested in such a receiver. This new receiver will not replace either of the three receivers I now have in production, but opens a large and completely new field we have not touched up to the present.**

## Communications Receivers

When Silver-Marshall, Inc. went bankrupt in 1932, it did not disappear. McMurdo Silver went his way with his new company, McMurdo Silver, Inc., but a company called Silver-Marshall Manufacturing Company continued on. This company had been formed in 1929 as a sort of holding company of Silver-Marshall, Inc. stock. It was inactive until Silver-Marshall, Inc. failed. Then William Halligan of Chicago acquired the use of its name. Later in 1933, ads for the Hallicrafter's All-Wave superheterodyne began to appear under the company name of Silver-Marshall Mfg. Co. It was designed by Kendall Clough, who had been the Chief Engineer of Silver-Marshall, Inc. This set was an attractive 13-tube receiver with good short wave and broadcast band performance, but it was not a communications receiver. That had to wait until Halligan got a 10-tube $49.95 radio out of the way early in 1934. By April of that year, the first Hallicrafter's communications receiver was introduced in a Silver-Marshall Mfg. Co. ad. It was a five tube superhet tuning the range of 12 to 200 meters in four bands with a vernier tuning control having a ratio of 18 to 1. The ad showed Captain Bartlett, who was said to be the highest ranking survivor of Admiral Peary's famous dash to the Pole, keeping in constant touch with his friends at Little America in the Antarctic. Shortly thereafter Halligan formed Hallicrafters, Inc., and began by advertising a 7-tube communications receiver called the Super Skyrider. It was offered at $59.95 complete with tubes.

It is not clear who built the first communications receiver, which in general was a set designed specifically for short wave reception and housed in a metal cabinet. During the 1920's, McMurdo Silver continually developed TRF communications receivers and in the 1930's superhets such as the 5A, B, C, and D, although he never claimed them among his forty firsts. Hollister of Lincoln Radio introduced a communications receiver, the R9, in 1933 and Hammarlund and National concentrated on communications receivers during the 1930's. Since typical communications receivers did not tune the broadcast band and emphasized features which were useful only to short wave listeners, it has to be assumed that the companies who introduced them thought that there was a significant market among amateurs or others for short wave reception. The others who bought communications receivers were governmental and military agencies in this country and across the seas. In the early 1930's, these sets were aimed primarily at the amateur market, but during the late 1930's the military demand was rising. As I mentioned earlier, Scott never had an interest in building receivers specifically for amateurs. However, the war was on from 1939, so finally he built a communications receiver in 1940 for various reasons-one of which was to show that he could build a professional set for users other than those in the home. Although Scott said that

many requests for a professional communications receiver had been received during the year before he designed the Scott Special, he built only a small quantity of these sets and did not push its sale to the public.

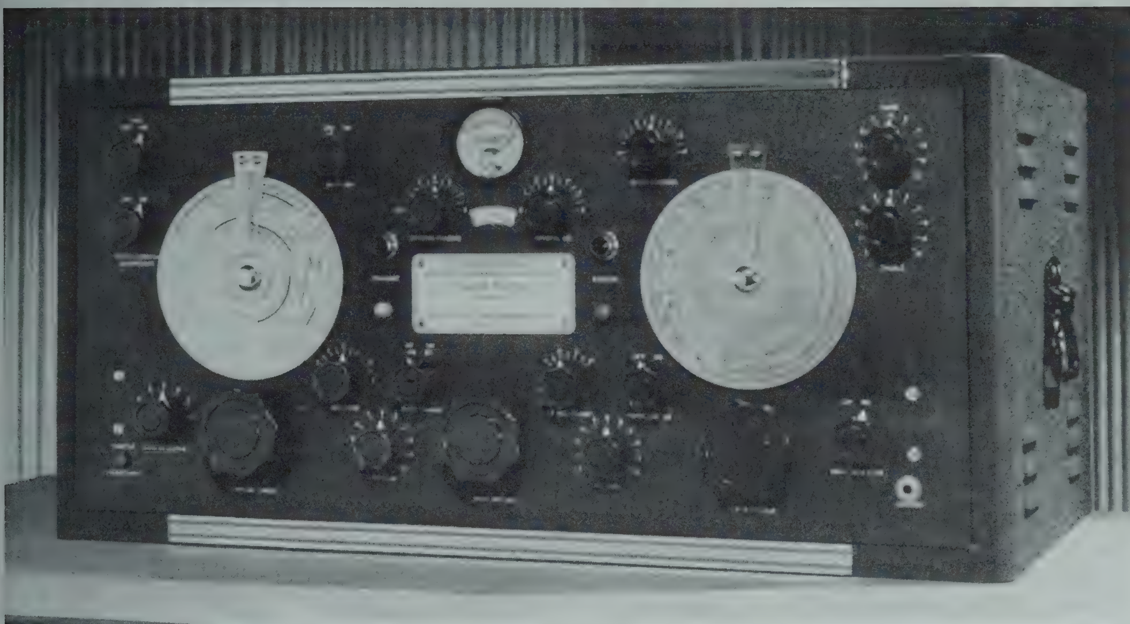
The Scott Special was a 26-tube receiver incorporating 22 separate controls, which Scott said was not recommended for the average listener but rather for the use of the professional radio engineer. It incorporated two completely separate tuners on the same chassis-one of which tuned from 60 MHz (5 meters) to 1500 kHz (the high end of the AM broadcast band) and the other tuned from 1600 kHz to 140 kHz (broadcast and long waves). Nine wavebands altogether were covered-seven of these for ultra high frequencies and short wave signals and two for long waves and the broadcast band. In addition to the calibration on the dials, individual graphs of the frequency versus the bandspread dial reading were provided. The Scott Special had the usual features of a professional receiver, including BFO and pitch control, antenna compensator, RF gain control and AVC on and off.

The Special had sharper selectivity than any other Scott receiver due to the crystal filter circuit in the input of the first i.f. amplifier, but with variable selectivity it could be broadened out to provide for high fidelity reception. Scott said "One big difference between my receiver and the standard professional set is that mine, although it is a professional receiver covering all wavelengths from 65 megs (5 meters) up to 2,000 meters, is actually a High Fidelity receiver. The professional radio operator is not so much interested in High Fidelity reception, and for this reason the commercial sets are notoriously deficient in tonal quality. However, being a lover of fine music, and especially of the new High Fidelity recordings, I certainly would not be content with any instrument designed purely for distance-getting. To me, the Scott Philharmonic is the highest type of instrument ever perfected for musical reproduction, so I have incorporated in the SPECIAL nearly all of its features. As a result, I can switch over instantly from a distant foreign short wave station to a local high fidelity broadcast or to my choice of superb recorded music. The record changer is in a separate cabinet in another part of the den."

"A very interesting feature on the SPECIAL is that it has not one tuner, but two separate tuners, both on the same chassis. Actually, I can have two stations tuned in on the SPECIAL at the same time, one on the Shortwaves, another on the Broadcast band, and by the flick of the switch marked "Wavechange" and without touching any other control, can bring in instantly either station. It is extremely interesting, when one of the local stations is rebroadcasting war news from Europe, to switch over and receive the same program directly from the European station, then by throwing the control switch, make an instant comparison between the reception direct from Europe, and the same program being rebroadcast from the local station."

"The average man who is interested in the reception of the major stations of the world, hardly needs a receiver of this kind, but for one to whom radio is a thrilling, fascinating hobby, this receiver is a dream come true."

Although the Scott Special was a very fine communications receiver, which satisfied Mr. Scott's personal needs very well, it was not the entree to military communications equipment. That step had to wait until later.



**Scott Special Communications Receiver**

# Chapter 10
# Introducing FM

## Pre-War FM

In early 1933, Major Armstrong filed patents on FM and by the end of that year had been granted US Patent #1,941,069. Concurrently, he demonstrated prototype equipment to executives and engineers of RCA, including his old friend David Sarnoff. The tests were so impressive that RCA backed Armstrong in the installation of a transmitter at the top of the Empire State Building and placed receivers at Westhampton Beach, 70 miles from New York, and at Haddonfield, New Jersey, 85 miles away. During the summer of 1934 and into 1935, Armstrong made test transmissions and compared FM with AM. However, by the winter of 1935, Armstrong had reached a state of disagreement with Sarnoff and others in RCA. RCA preferred to stake its future on television, so they ordered Armstrong to remove his equipment from the Empire State Building.

Although some welcomed FM as a healthy improvement in radio broadcasting and reception, many in the industry argued that FM was impractical, unnecessary, and even undesirable. Armstrong refused to accept these conclusions and proceeded to build at his own expense a high powered FM broadcast station at Alpine, New Jersey. A 400 ft. tower was constructed on a bank of cliffs 500 feet above the Hudson River and 17 miles from New York City. In the meantime, while the Alpine transmitter was under construction, a low powered (500 watt) amateur station located in Yonkers, New York was equipped with Armstrong's FM system. The performance of this low powered transmitter disposed of many of the reservations which had been advanced regarding FM. After witnessing the demonstrations where signals were received from the amateur station, the Yankee Network which operated a chain of stations throughout New England became interested in erecting FM broadcast stations at Paxton, Massachusetts and Meriden, Connecticut. Their entry into the FM field stimulated at least a dozen other broadcasters to secure construction permits and to begin the erection of FM broadcast stations. Also, the Alpine station went on the air on July 18, 1939. The performance of this station and those of the Yankee Network at Paxton and Meriden served to convince the broadcast industry that FM was here to stay.

By the autumn of 1939, 150 applications for licenses to operate FM stations had been filed with the Federal Communications Commission. The frequency allocation assignment, which had been made earlier for experimental licenses, was nowhere near adequate to accommodate all of these applicants. As a result the FCC suspended the granting of experimental licenses to review the situation and to consider RCA's contention that the standards being used were not the best. After a hearing held in March of 1940, the FCC approved the standards already in use in the experimental stations, removed the experimental limitation and arranged to issue commercial licenses as of January 1941. At the same time they assigned to FM transmissions the frequency range of 41 to 50 MHz, which provided for an increase of channel assignments several times that which was previously available. Actually FM, by this initial commercial assignment, took part of the frequency spectrum first assigned to television. This frequency allocation for FM broadcasting took care of that side of the business for the time being. Now it was up to the receiver manufacturers to provide for the other side of the business-that is, to bring FM to the listener.

In 1939, we saw FM as a natural for Scott Radio. So along with companies such as General Electric, Westinghouse, and Zenith Radio, Scott took a license under the receiver patents with Armstrong. However, there was considerable opposition to Armstrong's FM from RCA and Hazeltine, who held most of the radio receiver patents in the USA. They were in a position to sue anyone who tried to manufacture a set without their licenses. Of course, Scott Radio was licensed under both RCA and Hazeltine as well as Armstrong, so we had no problem there. Nevertheless, they tried to discourage anyone from using the Armstrong FM receiver circuits

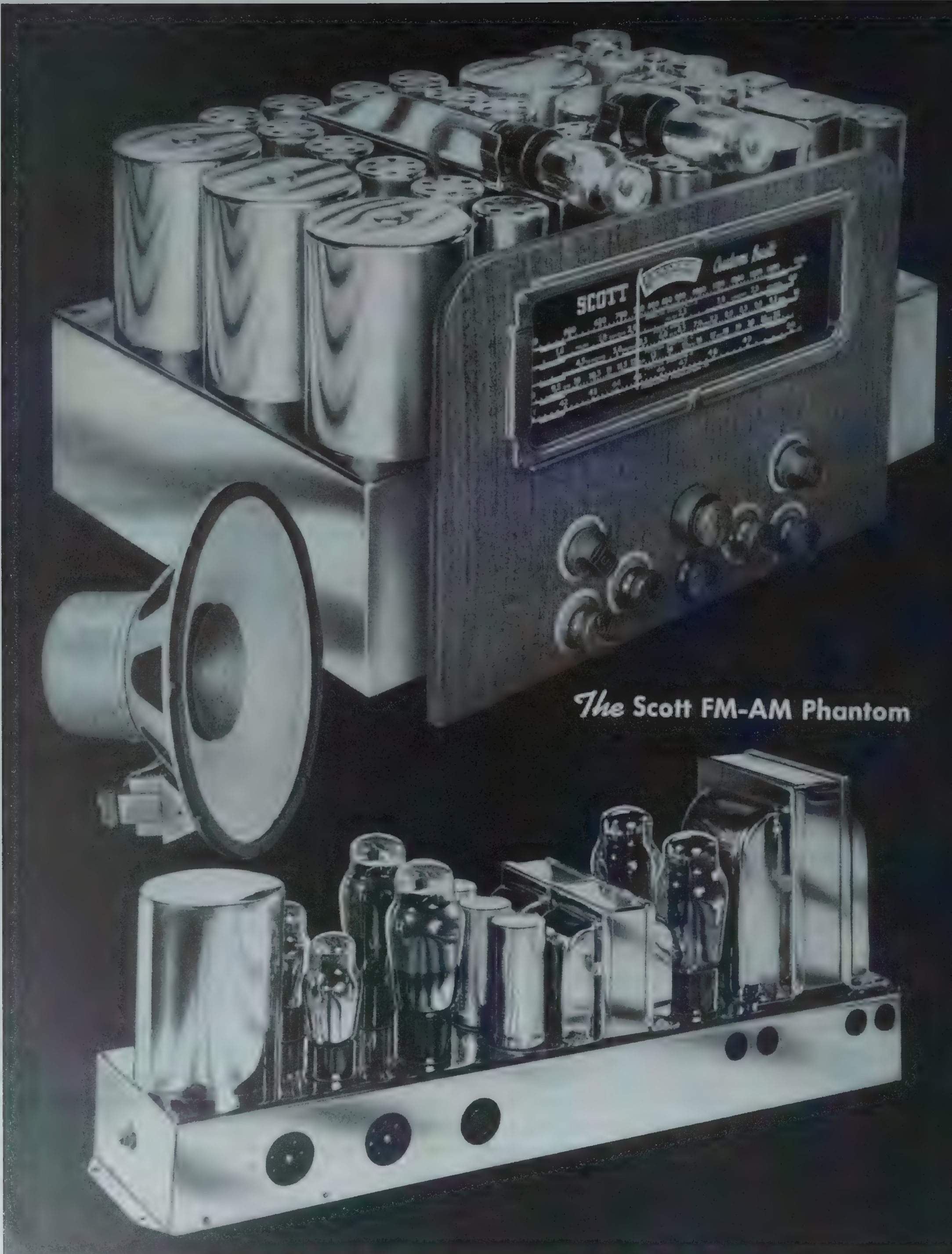
and offered another type of circuit using a ratio detector. Armstrong used limiters and a discriminator detector.

We proceeded with the Armstrong circuit in two directions-one to design an FM tuner which could be connected to the "phono" input of any radio receiver to provide FM reception through its audio amplifier, and the other to incorporate FM circuitry into Scott's two top models. These were the Philharmonic and the Phantom. In those days it was customary among receiver manufacturers to take new model receivers, after initial design and construction, to either the RCA or Hazeltine Licensee Laboratories for final testing and a sort of approval relative to performance. They might point out certain deficiencies in the receiver and either correct or suggest corrections to overcome the deficiencies. However, since we were using Armstrong circuitry and did not expect to get much help relative to it from RCA or Hazeltine, we decided to accept Major Armstrong's offer to test our models at Columbia University in New York City. He was Professor of Electrical Engineering at Columbia at that time. As our development work progressed, Scott and I took some units there for further testing. Upon our arrival we were greeted by Major Armstrong and introduced to his engineer, James Day. We found that he had the necessary test equipment to analyze the circuits thoroughly and to make the required tests. We could also listen to the Alpine FM station for direct test of reception under broadcast conditions. We had generally satisfactory results while there.

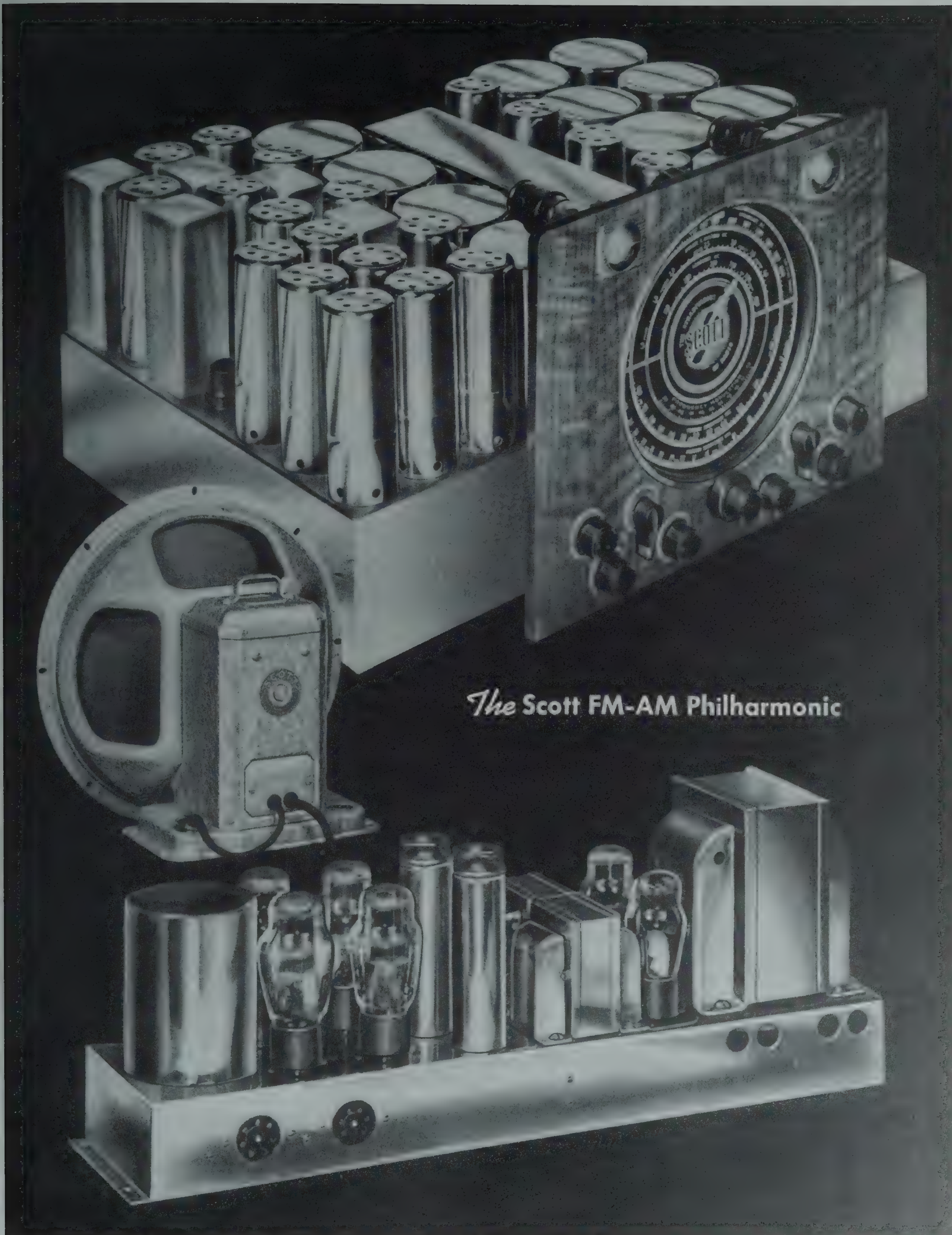
We returned to Chicago to complete the designs for production. Scott was not too keen about putting emphasis on the FM tuner and preferred to sell a complete FM-AM receiver. So in the Spring of 1940, the FM-AM Phantom model was introduced and concurrently advertised in Radio News. Later that year we introduced the FM-AM version of the Philharmonic. In all designs we used the optimum in Armstrong receiver circuitry with double limiters and a discriminator detector.

During 1940, we suffered from a limited amount of FM station programming as well as a limited number of stations. The local wanted stations were often too few and unwanted signals from distant points were often too many. The first situation was improved to some extent by providing our own FM signals from low-powered transmitters, which I built for use in our sales salons to demonstrate the tuners and AM-FM sets when insufficient local programming was available. The second situation which involved skip signals from distant transmitters, was more serious. It was thrilling to set up a receiver on the bench and bring in some distant FM station, but that possibility spelled trouble for the industry. It meant that distant stations could come in and interfere with local stations as well as in some cases even override them. I remember one occasion when we were visited by Paul de Mars, the Chief Engineer of the Yankee Network, who was generally pleased that we were building receivers which would expand the number of listeners to his stations. However, no sooner had he arrived than signals from his FM station on Mount Washington (about 1000 miles away) started pouring in like local signals. Although he did not show much reaction at the time, I felt that he must be somewhat disturbed by our DX reception of his FM station.

Although Scott built and sold a number of FM tuners and AM-FM receivers for operation in the 41 to 50 MHz band, sales were not nearly as good as they might have been due to the uncertainties mentioned above. Since FM, despite its glamour, was not the bonanza that one might have hoped for with a new series of products, Scott became quite concerned about the profitability of these new receivers and the tuner. To alleviate this situation a little he tried to induce Major Armstrong to reduce the royalty percentages which he collected under the terms of his licensing agreement. After all, we were still paying RCA and Hazeltine a percentage on all of the sets, which incorporated FM, as well as Armstrong. Despite Scott's pleas, Major Armstrong would not relax his royalty requirements. This led to considerable antagonism on the part of Mr. Scott toward Armstrong. Scott argued that much of the receiver depended upon other patents and that Armstrong should not claim a percentage on the entire receiver. The conflict continued somewhat to my dismay, because it meant that we were in effect being isolated from Armstrong and his laboratory because Scott did not wish to have any further contact with him. This hostility persisted and Scott and Armstrong were never friendly again. I met Major Armstrong once later at a convention. There he told me that he could not understand why Mr. Scott was so adamant about royalty reductions when his other receiver licensees were not objecting to his percentages. Scott and Armstrong never came to legal proceedings as far as I know. However, he had plenty of legal action with a score of other manufacturers who refused to license with him despite the fact that complete victory was won on his patents 13 years after his death.




*The* Scott FM-AM Phantom


The Scott FM-AM Philharmonic

# F-M RECEIVERS— DESIGN and PERFORMANCE

By MARVIN HOBBS
*E. H. Scott Radio Laboratories, Inc.*

ALTHOUGH it is to be expected that receivers for frequency-modulation reception will be somewhat similar in basic circuit design for some time to come due to the comparative infancy of the f-m art, they will differ somewhat in performance characteristics and in certain features which may affect their ability to do justice to the type of service which the wide band f-m system is capable of rendering. It is the purpose of this article to discuss the performance characteristics and the circuit features of the several models designed in the laboratories of E. H. Scott which provide reception of f-m signals in the tuning range of 41 to 50 megacycles.

*The U-h-f Superheterodyne*

As seen in Fig. 2 the first circuit of the superheterodyne is unconventional in that the input conductance of the r-f tube is neutralized. This is accomplished by connecting the grid return condenser to the cathode terminal on the socket of the 1853 tube, so that the voltage across the inductance in the leads of the cathode by-pass condenser can neutralize the degenerative effect introduced by the voltage across the cathode lead within the tube.[1] By choosing the proper ground point on the chassis it has been possible to make this neutralization effective over the 41 to 50 megacycle range and to improve the antenna gain and image rejection ratio by about 2 to 1. The 1853 tube is used in the r-f stage because of the desirability of a variable μ r-f gain control. When a u-h-f receiver is operated in the presence of strong signals it is very prone to produce a number of spurious responses because of the relatively poor selectivity of the u-h-f circuits with respect to signals whose frequency differs from the desired signal by only one-half of the intermediate frequency. It has been found desirable to reduce the r-f stage gain when signals of more than 50,000 microvolts are present at the antenna terminals in order to avoid receiving the signal at more than one point on the dial. In Fig. 3 the image rejection ratio of the Scott tuner using one r-f stage and the a-m f-m combination using two r-f stages are compared. The rejection ratio for the spurious response, which is due to the fact that the second harmonic of incoming signal as produced in the r-f or mixer stage beats with the second harmonic of the oscillator in the mixer circuit and there produces a signal at the intermediate frequency, is also shown as measured for the tuner. As mentioned above, if this figure is too low, strong signals can be tuned in at two points on the dial, although the second point is relatively weak and would appear to be so in an a-m receiver. However, because of the

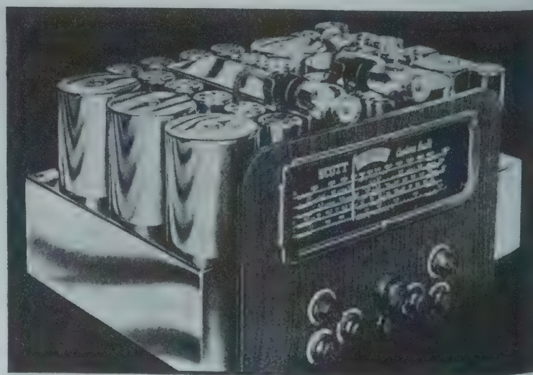


Fig. 1—The chassis assembly and the loudspeaker system of the Scott receiver. The loudspeaker system employs a 15-inch low frequency speaker for components below 2000 cps, two 5-inch tweeters for those up to 12,000 cps

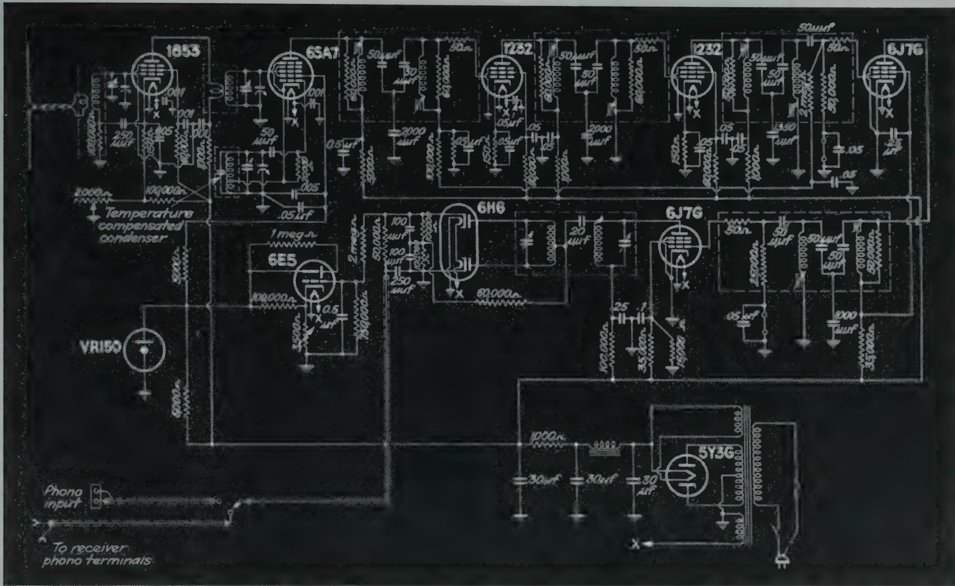



Fig. 2—Complete circuit diagram of the f-m tuner unit employing cascaded limiters

excellent limiter action of the f-m receiver both the correct and spurious signal may appear to be of equal audio level. The same consideration applies to the image signal.

Since the signal-to-noise ratio of converter tubes is relatively poor in the ultra-high-frequency band as well as elsewhere, it is desirable to obtain as much gain as possible before that point. In the f-m tuner the antenna gain is 6 and the r-f stage gain is 10 as measured under actual operating conditions (not as they can be measured by idealized vacuum tube voltmeter readings which omit the effect of the input conductance of the tubes). In the a-m f-m receiver employing two r-f stages an additional factor of 10 is added ahead of the mixer. These gains insure that the converter will have little control over the signal-to-noise ratio.

The 6SA7 tube is used as a mixer because of its oscillator stability. With no a-v-c voltage applied to this tube it is possible to vary the signal at the antenna from 1 to 100,000 microvolts with no shift in oscillator frequency. The other drift factor of importance is that experienced during the first few minutes of operation of the receiver. However, it will be noted from Fig. 4 that this has been reduced to a minimum in these receivers by means of a temperature compensated condenser. The maximum drift is seen not to exceed 3,800 cps which is comparable to the drift or frequency variation limitation at the transmitter.[3] In actual operation the receiver may be tuned after one-half minute of operation and it will remain tuned to the correct frequency except for the slight drift between the first and fifth minute.

Before describing the f-m performance characteristics it is well to consider the reasons for choosing an intermediate frequency of 5.25 Mc. The first consideration is that this higher frequency moves all image response signals from f-m transmitters in the 41 to 50 megacycle band outside that tuning range. Since these signals are likely to be the strongest ones capable of producing an image signal, the most serious possibility of image signal interference is automatically eliminated. Since the oscillator is tuned below the incoming signal frequency, transmissions in the band of 30.5 to 39.5 Mc are capable of producing image signals. However, with the image ratios shown in Fig. 3 there is little danger of any audible beat note interference with either the single stage or dual stage r-f systems. The second reason for choosing the high intermediate frequency is the obvious fact that it moves any spurious signal-producing voltages or image signals further along the r-f selectivity curve and makes the rejection ratios somewhat better than those obtainable with intermediate frequencies of 2,000 to 3,000 kc.

*F-m Performance Characteristics*

Once an intermediate frequency of 5.25 Mc. is chosen the problems of obtaining satisfactory f-m performance consist largely in obtaining the proper pass-band for a total deviation of 150 kc, sufficient adjacent channel selectivity, proper limiter action, and a linear discriminator circuit. The i-f amplifying section consists of two linear amplifying stages employing 1232 type loctal base tubes and two limiting stages containing 6J7G tubes. The last limiter feeds a 6H6 balanced detector across whose load the audio output voltage is developed. To insure freedom from regeneration and its ill-effects on the symmetry of the selectivity curve the sockets and wiring of each i-f stage are individually shielded. Plate and screen filters are also used to prevent audio voltage from the limiting stages from feeding back into the plate supply line, which is of particular importance in the combination a-m f-m receivers since such undesired voltages may feed into the audio system unless properly filtered and produce an audible output when the volume is adjusted to a low level.

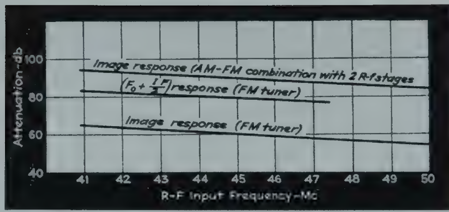



Fig. 3—Image and spurious - signal response of the two types of receivers

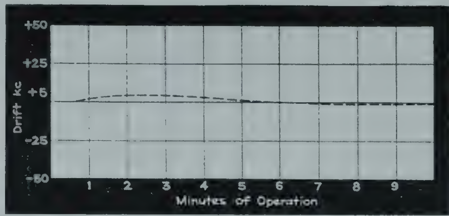



Fig. 4—Drift characteristic of the oscillator used in the receivers. Temperature compensation keeps the drift within 3800 cps

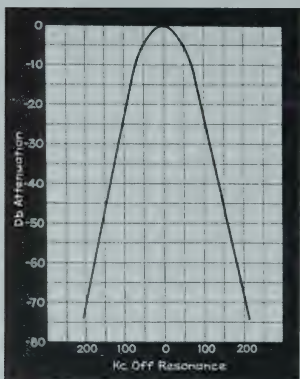



Fig. 5—Overall selectivity characteristic measured below input required for limiter action

The overall selectivity characteristic of the tuner is shown in Fig. 5. Three points along this curve are of particular interest. They are at 75, 125, and 200 kc from resonance. The 75 kc point is of importance because it shows the attenuation of the i-f amplifier at the maximum frequency deviation point. If there were no limiter present in the receiver it would be necessary to provide flat response over a range of 75 kc in order to prevent distortion. However, the cascaded limiters in these receivers operate at a signal input of only a few microvolts and can be depended upon to eliminate any amplitude modulation, which may result due to the selectivity characteristic, for all except very weak signals which would not be noise-free in any event. Listening tests and measurements indicate that the 12 db over-all attenuation at the 75 kc point produces no phase distortion of importance, provided the circuits are adjusted for optimum coupling. Without a certain amount of attenuation at this point it is difficult to obtain the desired degree of adjacent channel selectivity. At the 125 kc point, which is the edge of the frequency swing in the adjacent channel, an attenuation of 34.5 db, which is a measure of the immunity against cross talk from an adjacent channel signal, is shown. With this degree of adjacent channel selectivity we have found it possible to separate the signals of W9XEN, Chicago, on 42.8 Mc and W9XAO, Milwaukee, on 42.6 Mc. The listening test was made in Highland Park, Illinois, where the effective signal from W9XAO was about 20 microvolts and the signal of W9XEN was about 350 microvolts. A non-directional vertical dipole antenna was used.

In Fig. 6 the limiter characteristic for 25, 50, and 75 kc deviations is shown. It is desirable that these curves should be as flat as possible once they have passed the knee of limiter operation, in order to prevent any amplitude modulation due to the noise from reaching the detector, and in order to prevent the tuned circuit attenuation from causing distortion. About 3 db of variation of the amplitude due to selectivity can be tolerated and, therefore, the limiters may be assumed to be in full operation so far as distortion is concerned from a signal level 3 db below the input required to pass the knee of the curve. For signals below this level there is sufficient thermal noise from the first circuit to prevent noise-free reception. The dotted curve shows the noise attenuation characteristic insofar as the receiver itself is concerned. There is some question about the desirability of a sharp limiter characteristic for weak signals when a high level of impulse noise is present, and it is thought that the rounded initial characteristic shown in Fig. 6 is more desirable than a square shaped knee.

To reduce the effects of impulse noise it is necessary that the limiters be capable of acting very quickly. Hence, the limiter circuit time constants have been made as short as possible consistent with gain and selectivity of the limiter input circuits. From cathode ray oscilloscope studies it is apparent that a time constant of 2.5 microseconds or less is desirable. In these receivers the time constant of the first limiter grid leak and condenser is approximately 2.5 microseconds and that of the second limiter is 1.25 microseconds, thus assuring that the first limiter will be effective in reducing the peak interfering voltages of ignition impulses before they reach the second limiter. A minimum amount of a-v-c voltage from the first limiter grid leak has been applied to the control grids of the i-f amplifiers in some of the Scott receivers in order to prevent overloading in stages ahead of the limiter. However, the voltage used for this purpose has been kept low in order that the signal will be as far up on the limiter characteristic as possible and also to eliminate any delay in limiter operation which might result from the time constant of the a-v-c system.

In Fig. 7 the output characteristic of the discriminator detector is shown. This type of curve allows for a moderate amount of over-modulation at the transmitter without introducing distortion, yet it does not extend too far outside the channel to which the receiver is tuned[3]. The detector efficiency is such that no high degree of audio amplification is necessary after the detector in order to obtain adequate output, yet the signal level on neither de-

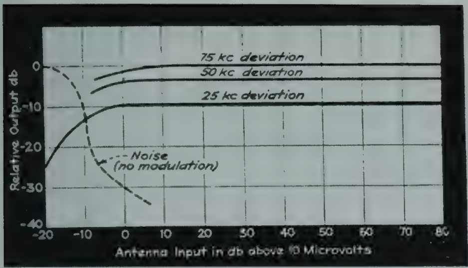



**Fig. 6—Limiter action curves for various deviations. The curves continue to be flat above plus 100 db**

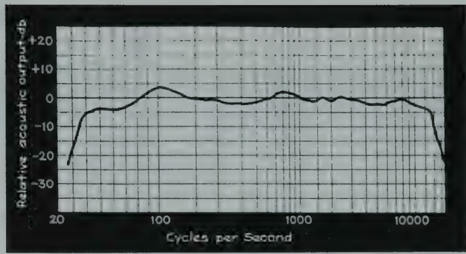



**Fig. 8—Sound pressure curve, measured in the Jensen Laboratories, of the loudspeaker assembly shown in Fig. 1**

tector drops sufficiently low to cause any appreciable rise of noise as the carrier is modulated[4]. Immediately following the detector load resistors a resistance-capacity filter is inserted to remove the pre-emphasis of the high frequencies which is introduced at the transmitter.

*Tuning Indication*

The problem of indicating the correct tuning point for a frequency modulation receiver is somewhat different from that encountered with an a-m set. There seems to be little doubt that tuning accuracy can be observed best by noting the voltage across the full discriminator detector load resistance. In a laboratory or communication type of receiver this voltage can be readily indicated by simply connecting a zero-center voltmeter of the proper sensitivity at this point. The receiver is tuned correctly when the volt meter is exactly between the symmetrical positive and negative voltage swings, or when it reads zero in this region.

Since it is no longer popular to employ any tuning indicator which smacks of the laboratory in a receiver for home use, it becomes necessary to consider tuning by means of a cathode ray "magic eye" tube which has been popular in home receivers for several years. However, exact resonance cannot be indicated by simply tuning for a peak response, as with the a-m receiver. The only practical solution seems to be one which uses the "magic eye" indicator to perform exactly the same function as the zero center volt meter, described above. In all of the Scott receivers this is accomplished by using a 6E5 indicator tube biased to cut off, so that the shadow just closes when no indicating voltage is applied to its control grid. The voltage for the 6E5 control grid is taken from the discriminator load circuit through an audio filter and, therefore, when the receiver is detuned in one direction the shadow opens and in the other direction it overlaps, the correct tuning position being for zero voltage from the discriminator with the shadow angle just closed. Practical tests with this system show that it is fully as accurate as the average zero center volt meter and that a good degree of stability is maintained when the supply voltages for the indicator tube are taken from a voltage regulated source.

The audio system of the combination a-m—f-m receivers requires a certain amount of consideration when switching from standard broadcast band a-m programs to the f-m programs. In order to obtain the maximum fidelity from the standard broadcast programs Scott a-m receivers have incorporated a high frequency boost choke in the plate circuit of the first audio stage to compensate for attenuation at the edges of the pass-band of the i-f amplifier. A peak of about 7 db is introduced at 6,500 cps for this purpose. For the reception of frequency modulation programs having a range of 15,000 cps such a peak is undesirable provided there are no corresponding deficiencies in other parts of the audio or loud speaker system. The presence of any peaks in an audio system of a wide-band f-m receiver is definitely undesirable for several reasons, one of which is the fact that they tend to exaggerate any noise which is modulated onto the carrier at the transmitter. In the Scott combination receivers a switch section is ganged with the wave band switch for the purpose of removing the high boost audio choke in the f-m position.

A low frequency boost choke capable of introducing a 7 db rise at its resonance point near 90 cps is present in the a-m receivers and has been retained in the combination receivers with the bass response control arranged so that it can remove or introduce this peak as the user may desire.

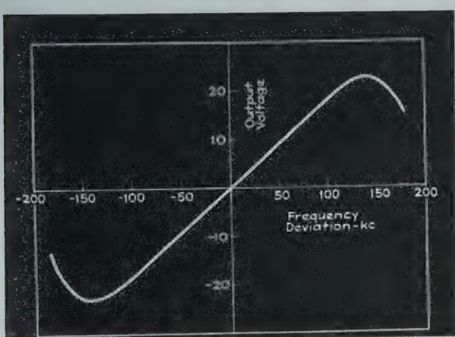



**Fig. 7 — Frequency detector (discriminator) characteristic designed for 75 kc deviation each side of the central frequency**

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[2] Notes on FM Transmitters, F. A. Gunther, *Communications*, April, 1940.
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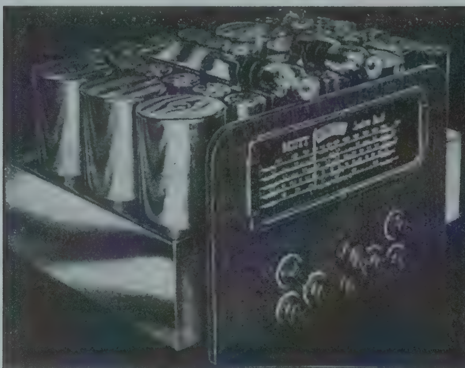


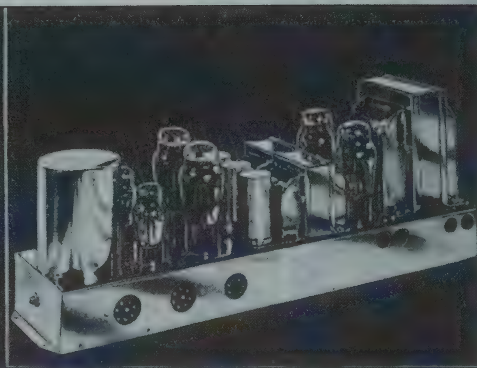


Fig. A, left. Tuning chassis of the Scott Phantom DeLuxe combined F.M. and A.M. hi-fi receiver. Note dual visual indicators. Fig. B, right. Chassis of the Phantom's power amplifier; its circuit innovations contribute to wide-range audio-frequency response.

### *Latest 28-Tube DeLuxe High-Fidelity*

# F.M. AND A.M. B'CAST RECEIVER

*Here is an exceptional custom-made all-wave receiver, combining amplitude and frequency modulation receiving systems, with a power output of up to 40 watts and a frequency range of 30 to 15,000 cycles! Its sound system therefore takes full advantage of F.M.'s hi-fi characteristic; the A.F. amplifier is particularly suitable for phonograph reproduction and includes a needle scratch suppressor system. Other circuit innovations are described.*

MARVIN HOBBS

THE receiver described here employs 28 tubes and is designed for the reception of *amplitude-modulated* signals in the frequency range of 540 kc. to 23 mc. (about 13 to 550 meters); and *frequency modulated* signals of the wide-band type in the frequency range of 41 to 50 mc.

The amplitude and frequency modulation sections are separate superheterodyne receiving systems up to the input circuit of the 1st stage of the audio-frequency amplifier, which is capable of handling either type of program with full fidelity and volume range as transmitted. Eight of the tubes function solely for the benefit of frequency modulation; 9 tubes for amplitude modulation; 8 tubes in the A.F. amplifier; 2 in the power supply and 1 tube as a common voltage regulator. Eight controls on the front of the chassis, including the tuning knob and its associated vernier, permit adjustment of the performance characteristics to meet varying conditions of reception.

#### THE R.F. SYSTEM

In Fig. A a front and side view of the main chassis is shown. The R.F. and I.F. systems and the 1st 2 audio-frequency stages are assembled on this base; with the remainder of the A.F. amplifier and the power supply on a separate chassis, which is usually mounted with the speaker system in the lower section of the cabinet. The variable condenser associated with the F.M. section is assembled on a common shaft with the standard tuning condenser, and both are housed under the long, rectangular shield toward the left-center of the chassis. The R.F. and mixer tubes of this section are located near this shield. The F.M. intermediate-frequency section is located on the extreme right-hand side of the chassis with the audio output feeding through a shielded cable to the band switch, where it is connected to the A.F. amplifier input circuit when the F.M. range is selected.

Separate antenna connections for the A.M. and F.M. are provided in the rear of the chassis, so that a double doublet system may be used for the shortwave- and

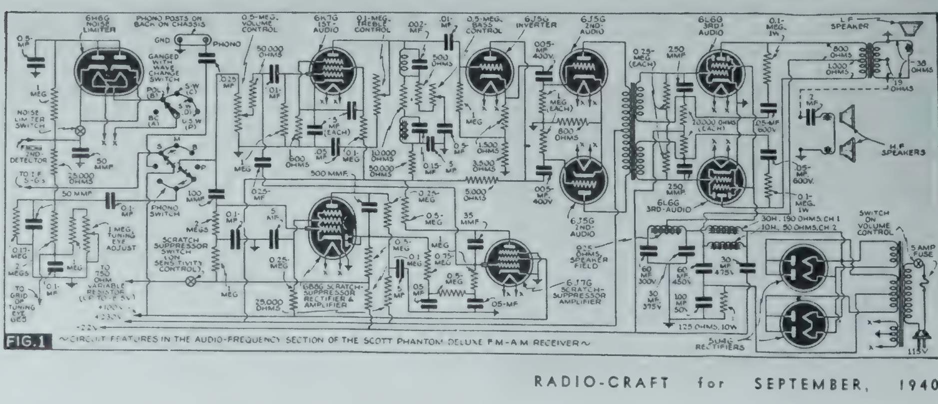


FIG. 1 ~CIRCUIT FEATURES IN THE AUDIO-FREQUENCY SECTION OF THE SCOTT PHANTOM DELUXE F.M.-A.M. RECEIVER~

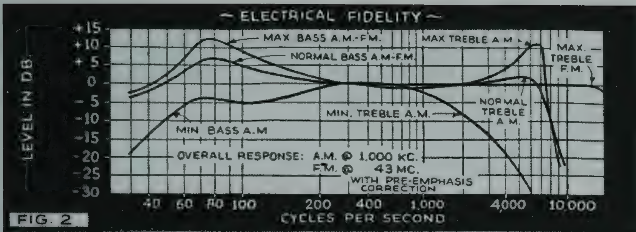



FIG. 2

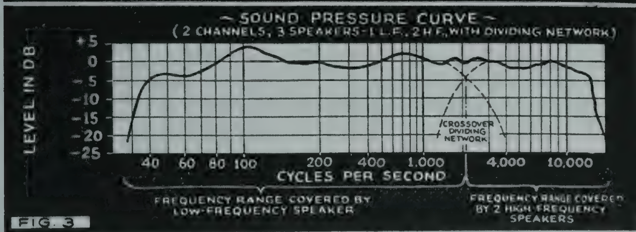



FIG. 3

broadcast-band signals, with a separate dipole of the proper length for the F.M. signals. This arrangement insures maximum efficiency on all bands and is quite practical where the listener is desirous of obtaining the best results. The F.M. antenna transformer is designed to match a low-impedance line and dipole as an added precaution against noise pick-up in the lead-in, which should be of the close-spaced type for this band. Electrostatic shield rings are employed between the primary and secondary windings of all of the A.M. antenna transformers to insure a minimum of noise pick-up from the lead-in.

### THE F.M. SYSTEM

In the F.M. section the high sensitivity level possible with this tube line-up results in limiting action on signals having a strength as low as 1 microvolt-per-meter. The screen-grid and plate potentials of the limiters have been adjusted so that the overall action is absolutely flat after the knee of the output curve is passed. Therefore, no distortion from any artificially-created amplitude modulation is possible once the limiters have commenced to operate. The I.F. selectivity is adjusted at the laboratory so that it is sufficiently broad to prevent phase distortion which can result when the selectivity is too sharp or unsymmetrical.

An intermediate frequency of 5.25 mc. is used to obtain high image and spurious signal rejection ratios; and the temperature-compensated oscillator operates on the low-frequency side of the incoming signal to avoid image signals from the television bands and to insure maximum stability.

The F.M. tuning indicator, which is located on the right-hand side of the chassis above the dial, is operated by the D.C. voltage across the discriminator load resistors and, therefore, it is a true zero-center meter. The discriminator circuits are properly loaded to eliminate distortion and are tuned by air dielectric condensers to prevent any drift in that characteristic. The peaks of this curve are separated by 250 kc. to allow a sufficient margin of linearity beyond the total wide-band modulation swing of 150 kc.

The adjacent-channel selectivity of the I.F. amplifier is such that any portions of the detector characteristic outside of the 200 kc. channel receive a minimum amount of voltage from any adjacent-channel signals.

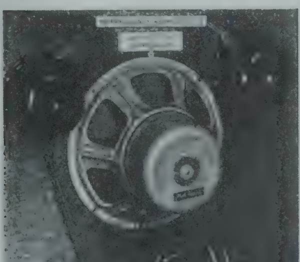


Fig. C. Loudspeaker system of the Phantom. The wide frequency response necessary to take full advantage of the high-fidelity characteristics of Frequency Modulation is due in good measure to the use of this triple-speaker sound system and associated matching network.

### THE A.F. SYSTEM

In Fig. B a view of the amplifier and power supply chassis is shown; the diagram of this portion of the receiver is given in Fig. 1. Degenerative feedback is used to keep the distortion level at a minimum. A maximum output of 40 watts, with approximately 35 watts of undistorted power, is available.

In Fig. 2 the electrical fidelity of the audio amplifier as it operates in both the A.M. and F.M. bands is shown. The high-frequency peak around 6,500 cycles compensates for the attenuation of the 455 kc. I.F. system used in all A.M. bands. This peak is eliminated in the F.M. position by contacts on the wave-band switch which selects all of the circuits required for that type of reception. Treble and bass response controls on the receiver provide a certain degree of quality adjustment.

To obtain a high degree of electrical fidelity a special loudspeaker system, Fig. C, consisting of 2 high-frequency tweeter units and one 12-in. low-frequency unit has been developed and has been found to provide a sound pressure response which is effective up to 15,000 cycles as measured on the axis of the high-frequency units. The high-frequency output energy is separated from the low-frequency energy by a constant resistance filter before it enters the high-frequency speakers. Figure C shows the speaker units mounted on a baffle together with the special filter network. The sound pressure characteristic is plotted in Fig. 3.

### PHONO NEEDLE SCRATCH SUPPRESSOR

An interesting feature in the audio amplifier is the *phonograph needle scratch suppressor system*, which is mentioned below in connection with the tube complement. It functions by reflecting an appreciable shunt capacity across the input terminals of the audio amplifier when weak audio voltages are applied. As soon as the audio signal level rises above the threshold level the shunting capacity is automatically removed and the fidelity is restored. The result is that relatively weak needle scratch and surface noise between the musical passages of a phonograph record are effectively silenced; but as soon as a musical passage appears, the audio voltage becomes sufficient to release the bypassing action. This circuit is also capable of increasing the intelligibility value of some weak A.M. signals in the shortwave band.

### TUBE COMPLEMENT

The tube complement of this receiver is divided in the following manner:

F.M. Section—1853, R.F. amplifier; 6SA7, mixer and oscillator; 1232, 1st I.F. amplifier; 1232, 2nd I.F. amplifier; 6J7G, 1st limiter; 6J7G, 2nd limiter; 6H6, discriminator detector; and 6E5, tuning indicator.

A.M. Section—6U7G, R.F. amplifier; 6L7G, mixer; 6J5G, oscillator; 6B8G, R.F. A.V.C. amplifier and rectifier; 6K7G, 1st I.F. amplifier; 6K7G, 2nd I.F. amplifier; 6B8G, 3rd I.F. amplifier, and 2nd-detector; 6H6G, noise limiter; 6E5, tuning indicator.

Audio Amplifier—6J7G, phonograph record scratch suppressor control tube; 6B8G, phonograph record scratch suppressor amplifier and rectifier; 6K7G, 1st audio amplifier; 6J5G, audio inverter; 2—6J5Gs, push-pull audio driver stage; 2—6L6Gs, push-pull audio output stage.

Power Supply — 2—5U4Gs, rectifiers; VR150, oscillator and tuning indicator voltage regulator.

*This article has been prepared from data supplied by courtesy of Scott Radio Laboratories, Inc.*

## The Last Scott FM-AM Receiver Design Before The War

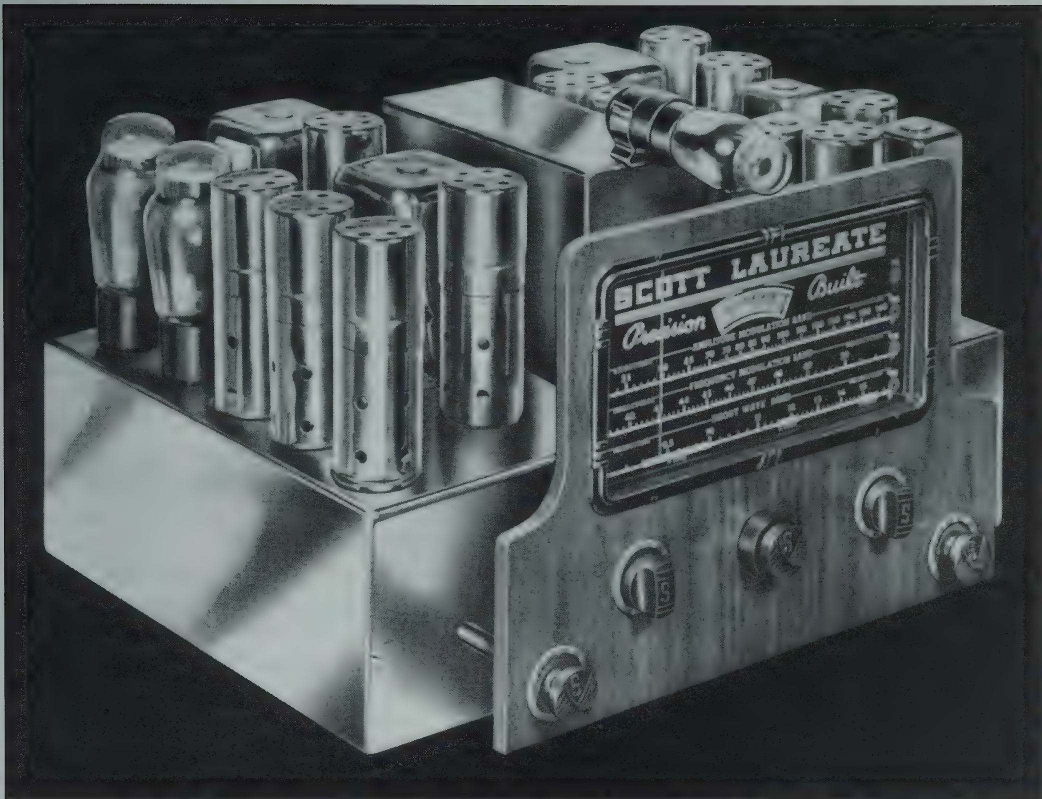
By June 1941, I was engaged in the design of a morale receiver to meet the requirements of the Naval Research Laboratory (see Chapter 11). On June 14th of that year, I checked the circuit diagram of the last Scott AM-FM receiver to be introduced before the United States entered World War II. This set was the Laureate. One might have called it a stepped-down version of the Phantom AM-FM receiver.

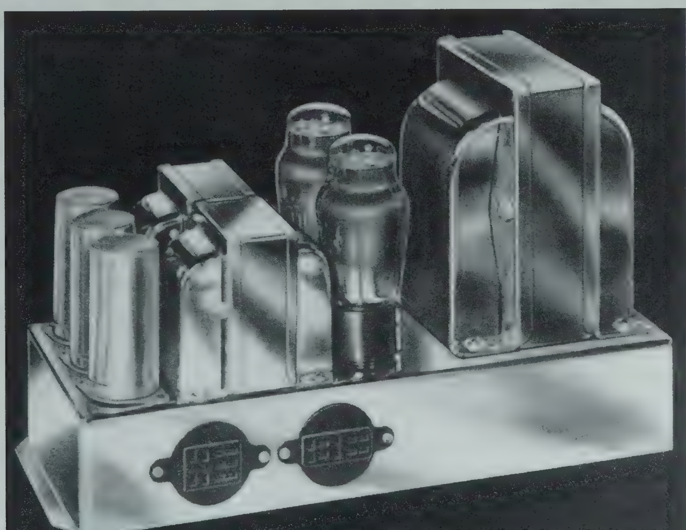
The Laureate had one less i.f. stage in its AM section and a single limiter instead of a double limiter in the FM section. The AM noise limiter, which came after the AM second detector in the Phantom was also eliminated in the Laureate. Altogether it turned out to be an 18 tube receiver, instead of the 28 tubes in the Phantom FM version.

The Laureate came with an AM broadcast band loop antenna, which provided adequate signal in many locations and which was appealing to those who could not install an outdoor antenna. It had only a single short wave band covering from 9.2 mc to 15.6 mc., and it also was provided with a loop antenna to be used where an external antenna could not be installed.

On the audio side, the two 6L6G tubes of the output stage were mounted on the main tuner chassis. Only the two power rectifier tubes and the power supply components were mounted on a separate chassis. The phonograph record noise suppressor, which was in the Phantom was eliminated. A circuit diagram of the Laureate is shown in Appendix B.

Although I do not recall that an objective of the Laureate design was to produce a high quality AM-FM receiver with a minimum number of parts, that certainly was the result. After December 7, 1941, parts for home receivers became very difficult to obtain. However, it was possible to produce the Laureate until the summer of 1942.



**Laureate FM-AM Receiver Chassis (Top)**
**And Mating Power Supply (Bottom)**

# SCOTT NEWS

NEWS OF LATEST DEVELOPMENTS IN THE SCOTT RESEARCH LABORATORIES

Vol. 13 | NEW YORK | DETROIT | CHICAGO | LOS ANGELES | BUFFALO | No. 1


## IN 18 YEARS NOTHING FINER THAN THE SCOTT LAUREATE HAS COME FROM OUR LABORATORIES

### A NEW RECEIVER DESIGNED PRIMARILY FOR THE FINEST HIGH FIDELITY REPRODUCTION OF LOCAL BROADCASTING PROGRAMS AND RECORDS

THERE are many thousands of radio enthusiasts in all parts of the world, who place quality of reproduction *first*. These lovers of fine music have dreamed that such an instrument as the Scott Laureate would be built some day—at a price they could afford to pay. It is for these listeners that we have designed this versatile new instrument.

E. H. Scott

The Scott Laureate is different from any Scott we have ever built *because it is the first time we have ever designed an instrument to do just one thing—reproduce the tone of every musical instrument and the human voice, either on radio broadcasts or records*—with a higher degree of tonal perfection than advanced engineering and skill were ever able to accomplish before.

The Scott Phantom and Philharmonic are, we sincerely believe, the most complete instruments of their kind ever designed and built. They not only have a tonal quality that has made them the choice of the world's leading musicians and music lovers, but also incorporate such a high degree of sensitivity that they bring to you programs from elusive or weak distant stations that are quite inaudible on the ordinary type of radio.

*But there are thousands of other listeners who are chiefly interested only in record reproduction and programs from local and semi-distant stations. It is for these enthusiasts that we have designed the Scott Laureate.*

This does not mean that you will be able to receive only local stations on the Scott Laureate. Although it is not considered a highly developed long-distance receiver according to the standards of the Scott Laboratories, *I nevertheless guarantee that it will outperform any other make of receiver designed for home entertainment in a side by side reception test.*

The final test every new Scott must pass is a very critical one in my own home. This last hurdle each new model must clear has changed many new developments, as I would not give a plugged nickel for any radio, no matter how remarkable its distance performance, if it did not have fine tonal reproduction.

I have been listening to the Scott Laureate for over a month. During the past eighteen years many wonderful instruments have come from the Scott Laboratories, but for tonal perfection I have never built anything finer.

E H Scott

# Chapter 11

# Morale Receivers and the Radiation Problem

## A Trip to Washington

In the Spring of 1941, Mr. Scott decided to take an auto trip to Washington, D.C. and other East Coast locations to try to get some feel for the direction that the company should take with the European conflict continuing to grow in intensity. It was becoming obvious that if the USA became directly involved in the war that the production of entertainment radios would be curtailed or prohibited. Since Scott Radio was known to most if not all of the top military personnel, it was not difficult for him to get appointments with the heads of communications and radio departments.

Scott decided to use his own car for the trip, because he wanted to see the countryside between Chicago and the East Coast. His main hobby outside of radio listening was photography. He had one of the best cameras that Bell and Howell made at that time. By taking his car he could have Mrs. Scott with him on the trip and by having me drive, he was free to have me stop wherever he saw a countryside scene which he liked for picture-taking. We took the northern tollways across Indiana and Ohio, but drove south before reaching Pittsburgh. In those days, a heavy pall of black smoke hung over that city, which was enough to scare anybody away. I had driven to the East Coast once before and knew that one could find good accommodations in the George Washington Hotel in Washington, Pennsylvania. So we stayed there overnight.

The next day we took off on Route 40 over the Appalachian mountains to Hagerstown, Maryland. During the trip across northern Maryland, Scott saw many scenes in the countryside which he chose to photograph. I stopped the car whenever he requested it. He often got out and walked to get into a better position for a good shot at the picture. As we drove toward Washington, D.C., we had to leave Route 40 and much of the natural scenery, which is so prevalent along mountain roads. I had to select my route so that we would end up on Pennsylvania Avenue near 12th Street, Northwest (the location of the Raleigh Hotel) because Scott had chosen it as our place to stay while in Washington. I never knew why he chose the Raleigh, but in those days it was a good choice for accommodations and service as well as being in close proximity to governmental agencies, particularly the military departments. The Army and Navy both had offices on that side of the Potomac at that time. The Pentagon building was not completed until January 15, 1943 (almost two years later).

After a night of rest, as I recall, Scott had some contact with the Australian and New Zealand embassies and later he and Mrs. Scott had dinner with some of the officials there. However, our main mission was to contact the military agencies relative to their radio requirements. Our first stop was at the Signal Corps, where we saw General Colton, the Chief Signal Officer. I shall never forget seeing General Colton sitting at the big desk and wearing his field hat. Since we had FM licenses with Major Armstrong, some of the conversation went in that direction. The Signal Corps had decided that they wanted their field radio equipment to use FM whenever possible. Of course, our licensing and development efforts had all been in the direction of entertainment radio receivers and we had no experience in the narrow band type of FM being developed for vehicular and handheld radio communications equipment. Motorola was to benefit from their work directed by Dr. Noble, another FM disciple, who had gone there from the University of Connecticut.

In those days, there was no separate Air Force Department. They were part of the Army and more specifically part of the Signal Corps. So when we saw General Colton at the Signal Corps, we had really covered the Army radio situation at the top at that time. To get into more specifics, General Colton had recommended that we stop at Fort Monmouth at Red Bank, New Jersey and see a number of officers, who specialized in various aspects of radio communications. Since Scott had

intended to stop by his showroom in New York City on the return trip to Chicago, it would be very convenient to stop at Fort Monmouth on the way to New York.

While still in Washington, we visited the Bureau of Ships in the Navy Department and saw its head, Admiral Dow (he later became Commodore Dow). Just as with General Colton, he told us that everything in radio line had to be approved by their technical people, who were at the Naval Research Laboratory, and suggested that we go there when we had something to offer. As I recall, we did not visit the Navy Laboratory during this stay in Washington, but planned to do it later when we had a receiver to present to them.

Since we were only trying on this trip to get some sense of the direction which we should take toward military radio, it appeared that we had accomplished about all that we could at this point. So we checked out of the Raleigh and headed toward New York City. As I recall, we stopped only briefly at Fort Monmouth, where we received further confirmation that Armstrong's FM would be widely used in Army radio equipment. In short, Major Armstrong's influence had been felt. As we drove toward Manhattan from Fort Monmouth, Scott and I had some discussions about what we had found about military requirements and occasionally he waxed quite freely about his conclusions. As I mentioned in another section, he became quite disconcerted with Major Armstrong over his royalty contracts for FM home radio and tuners. One of Scott's comments in the car at this time was to the effect that "bloody" Armstrong was certainly doing well in promoting his FM system with the military. The remainder of the trip into the city was relatively uneventful except for the usual traffic problems which one encounters on the way into Manhattan.

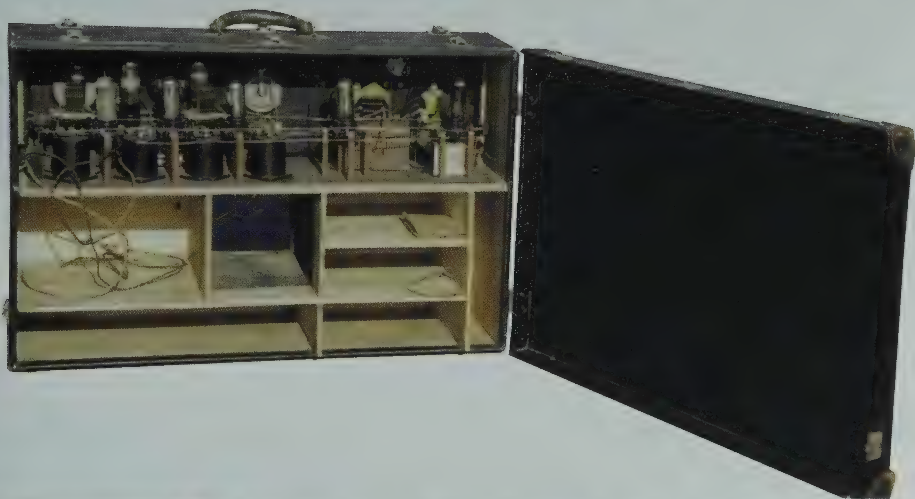
Our destination was the Barbizon Plaza Hotel. I can't recall why Scott had chosen that one either, except maybe he had stayed there before and knew about it. As we were checking in, Scott said that after a little rest we would go to dinner. So I went to my room to relax awhile and await his call. A little later, thinking that I had enough time to go to the lobby to purchase something, I went to the elevator and upon entering it I found Mr. Scott also going to the lobby. There he told me that we could not go to dinner together because Mrs. Scott was very angry with him and wouldn't even talk with him. I inquired why she felt that way. He said, "You remember in the car when I referred to that "bloody" Armstrong?" He said that Mrs. Scott thought that he had been very vulgar and offensive in using the word "bloody". So much for that evening. By the next morning, apparently, the incident had blown over. We all had breakfast together and Scott and I went off to the New York showroom.

We were trying to sell FM tuners and FM-AM combination radios but there was considerable uncertainty about whether the FM band, as authorized by the FCC, would remain 41 to 50 MHz. As I mentioned before, there was considerable skip signal activity at those frequencies, so it looked like a higher frequency band would be a better one for a satisfactory FM public broadcast service. Since FM had been incorporated into all Scott receivers, uncertainty about it affected overall sales. This situation made it even more important that we get back to Chicago and get something going to fit us into the military picture. So I headed the car back that way after a couple of days in New York City. As I recall, we did not do as much scenic sightseeing on the return trip as we did on the way to Washington.

Looking at military radio it was evident that we were in a weak position. Our development efforts had all been on home receivers. Although I had some experience with automobile radio and a small amount with aircraft radio direction finders before coming with Scott, we had little to offer in competition with companies like RCA, GE, Motorola, Collins, National or even Hallicrafters. Hallicrafters was certainly no giant in the communications field, but their product line at that time was communications receivers. Albeit many of these were inexpensive amateur types, but the better ones could be stepped up into products which the Signal Corps could use. Facing this situation I felt that we were in somewhat of a dilemma. I suppose that Scott may have felt that way, too, but for him hope sprang eternal.

## Radio and Morale at Sea

Upon returning to the laboratory in Chicago, Scott directed me to design and build a standard AM multiband (broadcast and shortwave) receiver housed in a black metal case. In short, essentially, an AM home radio in a case, which made it look like a communications receiver. Of course, it was to be a high quality unit in keeping with Scott tradition. Although my reaction was skeptical, I proceeded as directed. I did not believe that we could find a market for such a set. However, when I queried Scott about that point he appeared to believe that there would be a market for a morale receiver during the war. Millions of men would



**Duplicate World's Record Super Nine**
**Left By E.H. Scott In New Zealand In 1925**
(Photos Courtesy of John Meredith)

**World's Record Super Ten**
(Courtesy of John Slusser Collection)

**World's Record Super Eight**
(Courtesy of John Slusser Collection)

**World's Record Super Nine**
(Courtesy of John Slusser Collection)

**World's Record Super Nine Deluxe**
(Courtesy of John Slusser Collection)

**Shield Grid 9**
(Courtesy of John Slusser Collection)

**Shield Grid 9B**
(Courtesy of John Slusser Collection)

**AC10 (AC Screen Grid 10)**
(Courtesy of John Slusser Collection)

**Symphony**
(Courtesy of John Slusser Collection)

**ALLWAVE 12**
**in "Lancaster" Cabinet**
(Courtesy of John Slusser Collection)

**ALLWAVE 12 Deluxe**
**in "Lido" Cabinet**
(Courtesy of John Slusser Collection)

**ALLWAVE 15**
**custom installed in a**
**secretary-style desk**
(Courtesy of John Slusser Collection)

**ALLWAVE 15 Receiver Chassis**
**as purchased without a cabinet**
(Courtesy of John Slusser Collection)

**ALLWAVE 23 (5 knob version)**
**in "Tasman" Cabinet**
(Courtesy of John Slusser Collection)

**ALLWAVE 23 (7 knob version)**
**in "Laureate Grande" Cabinet**
(Courtesy of John Slusser Collection)

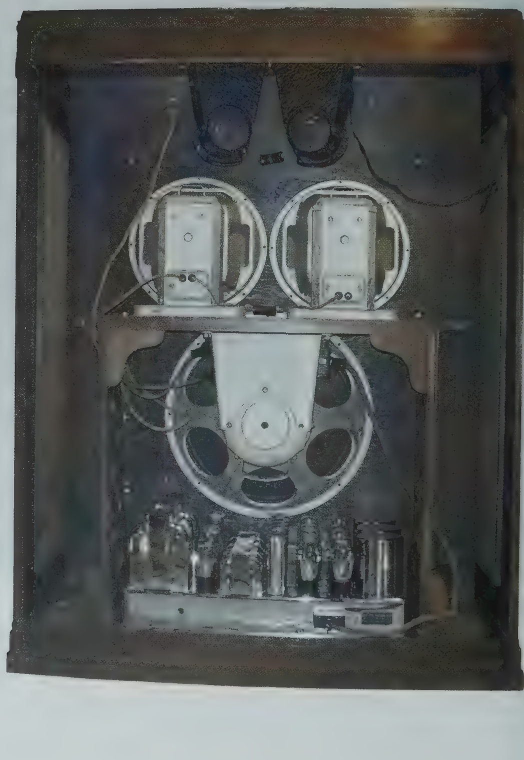
**"BABY" QUARANTA**
**(19 tube receiver and 8 tube power supply/amplifier)**
**in "Ravinia Grande" Cabinet**
(Courtesy of John Slusser Collection)

**"BABY" QUARANTA**
**in "Ravinia Grande" Cabinet**
**(receiver and turntable doors closed)**
(Courtesy of John Slusser Collection)

**Quaranta - Receiver Cabinet**
(Courtesy of Norman Braithwaite Collection)

**Quaranta - Recording Cabinet**
(Courtesy of Norman Braithwaite Collection)

**QUARANTA**
**Speaker Cabinet-Front View**
(Courtesy of Norman Braithwaite Collection)



**QUARANTA**
**Speaker Cabinet-Rear View**
(Courtesy of Norman Braithwaite Collection)

**Quaranta - 5 Chassis Set - 48 Tubes**
(Courtesy of Norman Braithwaite Collection)

**AM Philharmonic**
**Pointer Dial Version**
**in Custom Cabinet**
(Courtesy of Norman Braithwaite Collection)

**AM Philharmonic**
**Beam-of-Light Dial Version**
**in "Waverly Grande" Cabinet**
(Courtesy of John Slusser Collection)

**Sixteen**
**in "Wilshire" Cabinet**
(Courtesy of John Slusser Collection)

**Sixteen**
**in "Braeside" Cabinet**
(Courtesy of John Slusser Collection)

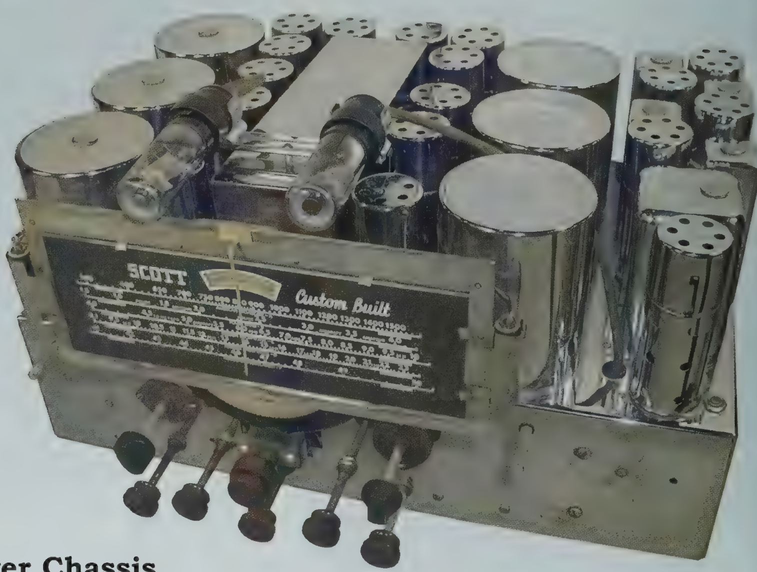
**Super XII**
**in "Braemar" Cabinet**
(Courtesy of John Slusser Collection)

**Masterpiece**
**in "Louis XV" Cabinet**
(Courtesy of John Slusser Collection)

**Phantom**
**in "Westwood" Cabinet**
(Courtesy of John Slusser Collection)

**Phantom Deluxe**
**in "Braemar" Cabinet**
(Courtesy of John Slusser Collection)

**FM Phantom**
**in "Acousticraft" Cabinet**
(Courtesy of John Slusser Collection)



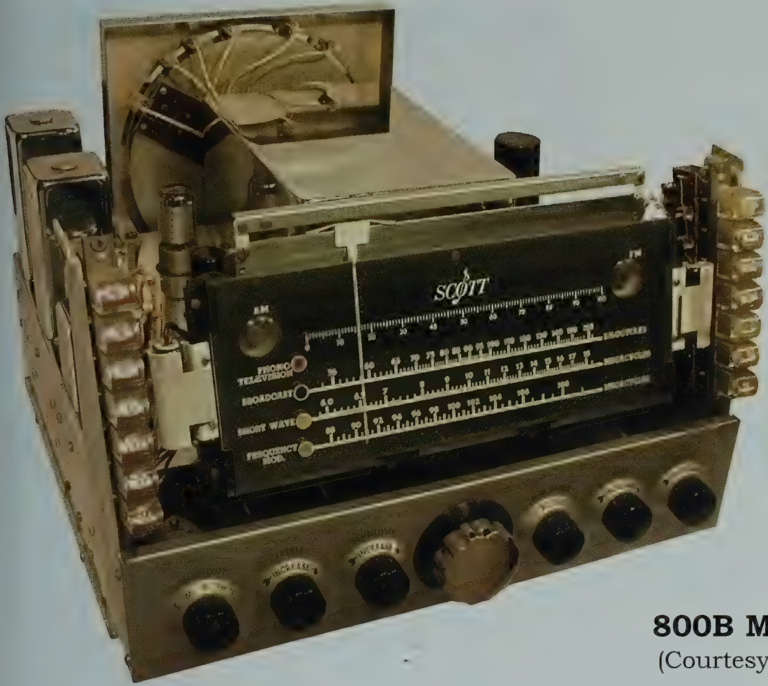

**FM Phantom Receiver Chassis**
(Courtesy of John Slusser Collection)

**FM Philharmonic Receiver Chassis**
(Courtesy of John Slusser Collection)

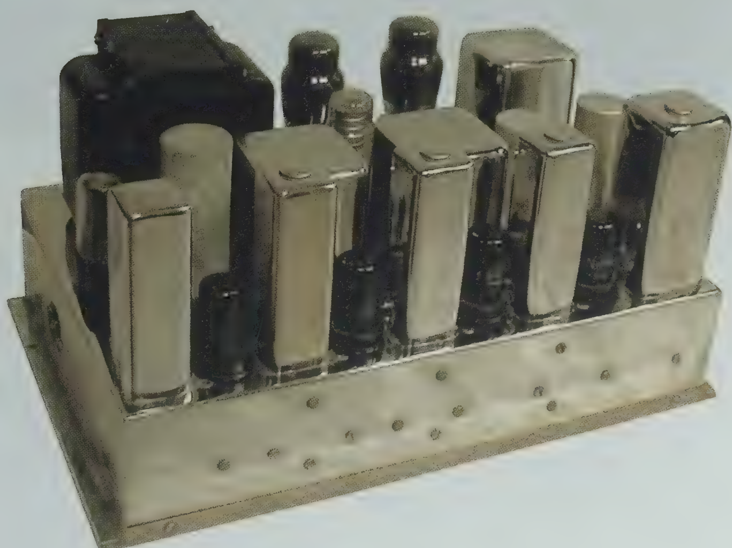
**FM Philharmonic**
**in "Gothic Grande" Cabinet**
(Courtesy of John Slusser Collection)

**Laureate**
**in "Regent" Cabinet**
(Courtesy of John Slusser Collection)

**Laureate Speaker**
**in matching "Regent" Cabinet**
**using "Sound Board"**
(Courtesy of John Slusser Collection)




**800B Main Receiver Chassis**
(Courtesy of John Slusser Collection)



**800B FM Section, Power Supply and Audio Power Amplifier Chassis**
(Courtesy of John Slusser Collection)

**Model 800BT**
**AM, FM, Shortwave, Phonograph and Projection Television in a "Chippendale" Cabinet**
(Courtesy of John Slusser Collection)

**RCA Berkshire**
**in “Regency” Cabinet**
**open to AM-FM radio tuner**
(Courtesy of Chuck Dachis Collection)

**RCA Berkshire**
**in “Regency” Cabinet**
**illustrating projection TV**
(Courtesy of Chuck Dachis Collection)

**RCA Berkshire**
**in “Regency” Cabinet**
**(back view of cabinet)**
(Courtesy of Chuck Dachis Collection)

**RCA Berkshire**
**in "Regency" Cabinet**
**open to AM-FM radio tuner**
(Courtesy of Chuck Dachis Collection)

**RCA Berkshire**
**in "Regency" Cabinet**
**open to AM-FM radio tuner**
(Courtesy of Chuck Dachis Collection)

**RCA Berkshire**
**Audio and Power Supply**
**Chassis**
(Courtesy of Chuck Dachis Collection)

be away in foreign lands and there would be a need for them to listen to American short wave broadcasts as well as local broadcast band stations in the countries where they were based.

Although I did not think of it at the time, Scott's inspiration for a morale receiver may have come at least in part from the club which he formed and operated in Chicago for Australian and New Zealand servicemen during the war. After all, they were in it as a part of the British fighting forces since 1939 and several of them had passed through Chicago before 1941. Also, many of them came down from Canada where they were being trained before going into combat service. He treated these men royally when they came to Chicago, taking them on sightseeing tours, to baseball games and providing a social haven for them. Perhaps, it was there that he saw and felt the importance of morale for soldiers and sailors thousands of miles away from home. He experienced at first hand their need to hear from home and remembered his own need to hear from home during World War I when there was no radio available for that purpose.

In any event, we proceeded with the development of the morale receiver. Because of the loneliness in warships at sea, Scott thought that he had a better chance to interest the Navy Department rather than the Army in such a set. After a few months he contacted Admiral Dow, whom we had met during our trip to Washington earlier in 1941, and told him that he had a radio which he would like to show the Navy. Apparently, this resulted in an appointment with T. McL. (Tommy) Davis, the Head of the Radio Receiver Section at the Naval Research Laboratory in Anacostia, Maryland. Scott asked me to accompany him and bring the morale receiver. Once again I was skeptical, thinking why would the Navy buy such a set to keep sailors happy when they had so many operational requirements. I guess that I had not yet realized the importance of morale in wartime.

When we went to the Naval Laboratory, we spent some time with Mr. Davis and his assistant, Mr. Toth. Apparently, the Navy had a great interest in such a set, but there was one requirement which absolutely had to be met. It must not radiate signals which could be picked up by enemy submarines. The direction finding equipment on the German submarines was highly sensitive. U.S. vessels had to observe radio silence to the utmost except for absolutely essential communications. Of course, a transmitter of even low power would provide an ideal signal for a German submarine to home a torpedo on; even superheterodyne receivers with their local oscillator could radiate signals strong enough for submarines to target their weapons. We were advised that our morale receiver was fine, but it radiated far more than the Navy could tolerate with any degree of safety. However, such radiation was typical of all similar receivers which the Navy had tested and had been reduced to a satisfactory level only in expensive communications receivers, which were being installed for fleet operations. So we had received either bad news or good news. The bad news was that we could not sell our radio in its present form to the Navy. The good news was that if we could solve the radiation problem, we could look forward to a considerable demand from the Navy.

## Solving the Receiver Radiation Problem

So we returned to the Laboratory in Chicago and I contemplated possible solutions. Fortunately, as I mentioned earlier, I had worked on automobile radios during most of the 1930s before going with Scott. In those days before the advent of transistors, vibrator power supplies were used in automobile radios to step up the voltage from the car battery to a level suitable for tube operation. The vibrators generated considerable radio interference and one of the major problems in designed an auto radio in those days was to reduce the effect of the so-called "hash" to a tolerable level by filtering, grounding and placement of components. I saw the oscillator radiation problem as a similar one, so I decided to apply every technique which I had used in the vibrator case to the filtering, grounding, and isolation of the receiver's local oscillator. I tried this procedure and it worked.

Without going into all of the technical details of my solution to the receiver radiation problem, it resulted in US patent number 2,314,309, which was granted March 16, 1943. Here again I was somewhat surprised because I thought that the Naval Research Laboratory would have already solved this problem well ahead of me. Of course, patent applications take awhile to go through the Patent Office. So long before the patent was granted, our morale receiver was accepted by the Navy and Scott Labs received orders for thousands of morale receivers with the low radiation feature covered by my patent.

## Morale Receivers for the Navy

One interesting aspect of the final design was that our receivers (the RBO series) were not provided with loudspeakers. The sets were grouped in quantities of four or more and were tuned to different stations. The four or more separate audio signals were fed around the vessel to many individual small amplifier speaker combinations. These units were provided with a switch to select any one of the four or more channels available from the receivers. Thus, the user could choose as many programs as the number of receivers would provide. This arrangement kept the receiver tuning under the control of personnel at a central point or in the radio room. Undoubtedly there were variations in the size of the receiver groups depending upon the size of the vessel. This approach resulted in the Scott morale receivers appearing in various quantities on every vessel of any significant size in the US Navy during World War II.

Later in the war, other versions of these receivers (the SLR series) were developed for the Maritime Commission for use on Coast Guard and merchant marine ships. These sets were ordered and produced in some quantities. Also, in a receiver (the model RCK) designed for use on aircraft carriers to receive signals from Naval aircraft in the frequency range of 115 to 156 MHz, we applied the patent to reduce receiver radiation to an acceptable level. This receiver provided for reception on any one of four channels in this frequency range by selecting crystals in the oscillator section. We built a complete receiver with the preselector for the 115 to 156 MHz range as a plug-in module. Thus, other preselectors could be used to replace the one which we had built to extend the receiver's tuning range to microwave frequencies for signal search purposes. We did not build the preselectors, which tuned above 156 MHz.

Finally a morale receiver (the model SLR-M) was built with its own loudspeaker and an AC/DC power supply. One of the government agencies placed orders for several thousands of these sets before the end of World War II, but cancellations of these orders came at the end of the war. As a result, these sets were offered to the public by Scott Labs. However, since they had only the audio output of a typical table model radio of average fidelity, they seemed to be somewhat out of the Scott tradition of high power and high fidelity. The features which enhanced them as far as the Navy and Maritime Commission was concerned did not particularly enhance them for individual use. No further units of this type were offered to the public after the cancelled quantities were sold following the end of the war.

I should not fail to mention that other receiver suppliers to the Navy tried to compete for the morale receiver business after Scott had built the first quantities, but initially they failed to pass the radiation tests of the Naval Research Laboratory. The companies in particular who tried for these orders were the Radiomarine Division of RCA and the National Company of Malden, Massachusetts. They tried other approaches of filtering and grounding around the receiver's oscillator, but as far as I know Scott supplied all of the low-radiation morale receivers that were purchased by the Navy and Maritime Commission during World War II.

Before the war ended, the E.H. Scott Radio Laboratories received the Army-Navy E award as well as the Maritime M and the Treasury T awards. The news began to get around about Scott's activity in this field. Other manufacturers heard about and wanted to know why they did not get an opportunity to build these sets. I remember that a representative of the Zenith Radio Corporation came to me in Washington during 1944, while I was a consultant to the Radio and Radar Division of the War Production Board and said that Commander McDonald, who was still the head of Zenith, wanted to know why Zenith did not get an opportunity to build the morale receivers for the Navy. He said that the Commander might threaten an investigation to learn why he did not have a solicitation for these orders. I told him to have an investigation if they chose to do so and explained the history of our entry into this business. I assured him that we did not get orders for these sets through politics but rather by the sweat of our brow. We had even been granted a patent to prove it.

## Receiver Radiation-An Historic Problem

Actually receiver radiation had been a problem all the way back to World War I. When regenerative receivers were used by the military they could always break into oscillation and radiate a signal which could be picked up by enemy receivers. It was said that aircraft often gave away their location by such radiation. Then the superheterodyne was invented by Major Armstrong. While it offered definite advantages to the military by enabling them to use a wider range of transmitting frequencies, it had an oscillator which operated all of the time while the receiver was in use. So if anything, the receiver radiation


*Amazingly enough,* **shipboard radio receivers "tattled" to enemy subs . . .**

*until the danger to ships and men brought forth the* **Scott Marine Model Radio!**

Do you know why the Federal Communications Commission banned all shipboard entertainment radios? Because, the instant they were turned on for listening they divulged the ship's position . . . much farther than the 10 or 15 miles most officers and men believed possible. Actually a receiving set rebroadcasts a signal *detectable as much as 100 miles away* by sensitive enemy direction-finders.

To eliminate this hazard, the Federal Communications Commission urged radio manufacturers to develop a *safe* radio for use at sea. In less than a month Scott engineers invented a special Marine Model that can't be detected 25 feet away—fully approved by the Federal Communications Commission!

The Scott Low-Radiation Receiver is the *first* radio that can be operated with complete safety on *both* the broadcast and shortwave bands essential to good reception far from land under difficult shipboard conditions. The SCOTT has become the toast of seamen and sailors wherever ships now sail. You'll soon find SCOTTS on tankers, on merchantmen, on American ships of every kind as fast as we can get them there . . . giving our men at sea the programs, the news from home, the relaxation they need and deserve, *in safety.*

**SCOTT**
*Marine Model*
LOW-RADIATION
**RECEIVER**

• The Scott Marine Model is for marine use exclusively and is available for shipboard installations under priority ratings.

**SCOTT**
**FINE RADIO RECEIVERS**

E. H SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Avenue, Chicago

**1943 (Wartime) Ad Describing Scott Low-Radiation Morale Receivers**

problem was aggravated. However, a young engineering assistant to Major Armstrong set to work to remedy this basic fault of the superheterodyne. This young engineer, Jackson H. Pressley, invented a method of reducing superhet receiver radiation through a bridge circuit between the antenna and the input of the first detector. The local oscillations which would have fed into the antenna to be radiated were cancelled in the bridge arrangement. This solution provided beneficial results in World War I. Later in 1924, the Pressley superhet was displayed at Radio Shows and the Sangamo Electric Company of Springfield, Illinois, offered a kit from which the Pressley superhet could be constructed. Although there was considerable interest in this circuit among kit builders for a year or two, it was not as popular as it might have been due to the fact that its only feature was the reduction of receiver radiation. The remainder of its superheterodyne circuit had no unique features. While radiation of receivers to the annoyance of other listeners was deplored by the radio industry, set manufacturers felt that the average radio fan would not spend more money to buy a set which had low radiation.

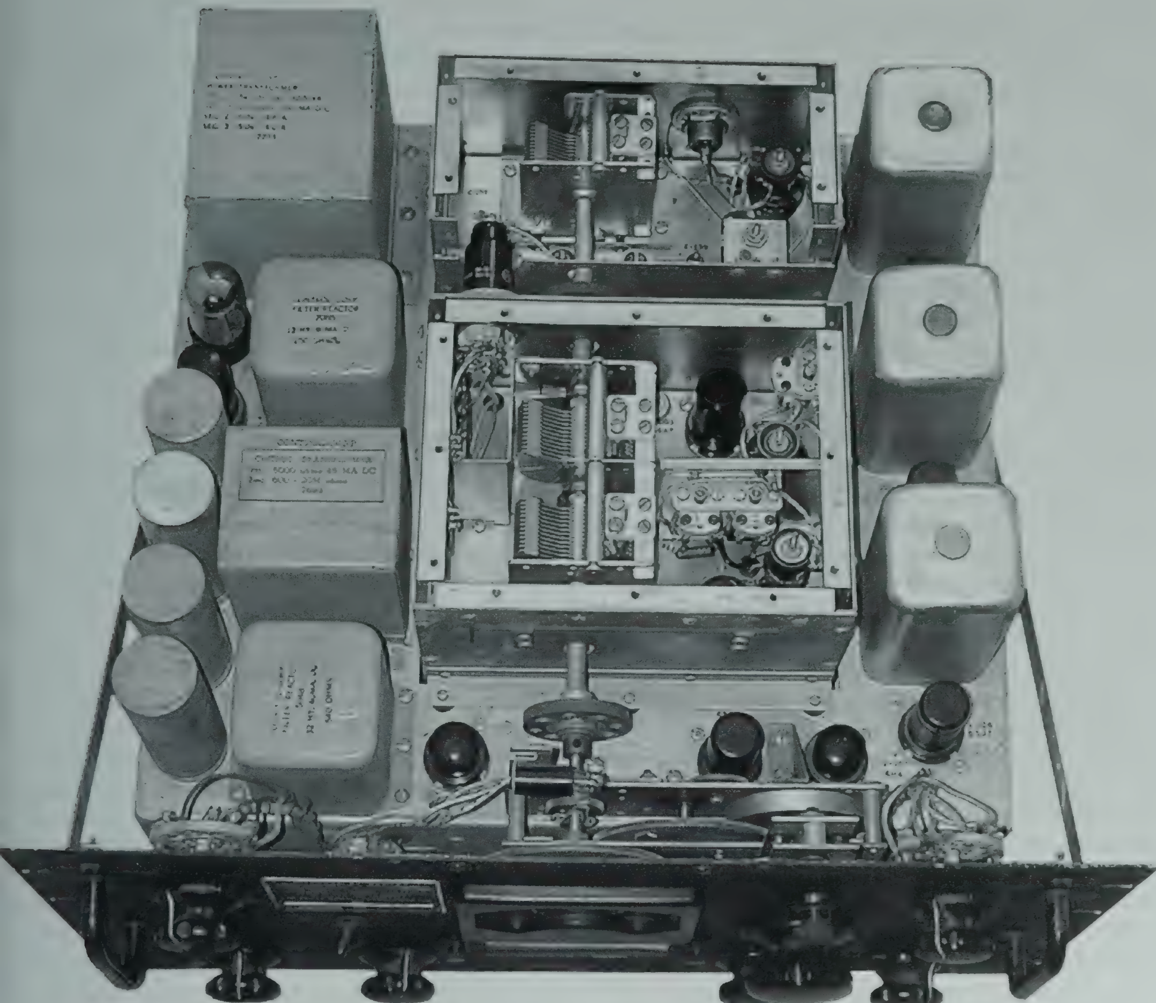
After World War I, Pressley stayed in the Army. He advanced to the grade of Captain and became chief engineer of the Signal Corps Radio Laboratories which were located at Camp Alfred Vail in New Jersey during the 1920's. In that capacity, he was the designer of the Army's standard aircraft radio receiver using his low radiation invention. Later in the 1920's, he left the Army to accept engineering positions in the radio industry. In 1930, he was chief engineer of the US Radio and Television Corporation at Marion, Indiana where I first went to work as an engineering assistant in the autumn of that year. However, I was a couple of layers in the organization below the chief engineer so I really never had much contact with him. As I recall, I met him when I was interviewed and later while working I would see him when he came through the laboratory. I did not even learn about his superhet invention. In college we had been taught the technical principles of radio operation and circuitry, but not the history of receiver development.

As I mentioned above, on the non-military side, receiver radiation was deplored from the early 1920's because receivers often disturbed neighbors by radiating signals which produced whistles and squeals to interfere with their reception. When RCA brought out its second harmonic superhet in 1924, it had to place an r.f. stage ahead of the first detector to provide a so-called "blocker" stage to reduce radiation to an acceptable level. A little later A.H. Grebe and Company brought out an accessory called a "squeal squelcher." This device was connected between the input of the receiver and the antenna. A balancing effect in its input circuit cancelled radiation before it could be radiated by the receiving antenna. The desire to do something about home receiver radiation reached a peak in 1924 when the highest percentage of sets in use were of the regenerative type. Proposals included the prohibition of single input circuit and regenerative receivers and a variety of antenna circuit and blocking schemes. Pressley's superheterodyne with its balanced bridge input circuit attracted most attention as a possible solution during 1924 and early 1925. However, interest waned as more tuned radio frequency sets often with neutralization were offered by manufacturers and even when the use of superhets increased later the addition of an r.f. stage was about the most that was added to reduce radiation. Even then that was not its real purpose. It remained for another war to spur military demand to provide new solutions.

When I tackled the receiver radiation problem in 1941, I knew nothing about the above history and while I knew that an r.f. stage between the first detector and the antenna was essential, I really started there because I had that stage already. I doubt that any balancing or bridge arrangement would have worked over the frequency bands to which we had to tune our morale receivers. Any balancing scheme would have probably required special antenna installations, which would not have been practical on many ships. Finally, the order of radiation reduction required was somewhat greater than had been realized by earlier solutions. This was evidenced by the difficulty our competitors had in trying to develop receivers to meet the Navy's requirements.

Since mid-1941, I had worked on the solution of the receiver radiation problem. We had also received approval of a receiver by the Naval Research Laboratory as well as a contract for its production from the Bureau of Ships. However, a patent was not applied for until February 2, 1942. Then it was not possible to describe the specific purpose of the invention in any detail due to security restrictions at that time. It was decided just to call it a "Radio Receiver" and I made the following statements in the patent application:

*This invention relates to improvements in receiving systems for radio signals and more particularly to improvements in the method and apparatus of preventing*



**Top View Of Low Radiation Chassis (Model RCH)**
**With Covers On RF and Oscillator Compartments Removed**
**(Courtesy of Max A. Kaplan)**

*undesirable radiations from the receiver.*

*As is well known, the so-called super-heterodyne types of receivers include in their combination a local oscillator, the purpose of which is to generate a local signal, which signal is mixed with the incoming signal to provide a heterodyne or beat signal that is the difference between local and received signals, which beat signal is amplified, detected, and eventually reproduced audibly.*

*Heretofore the radiation of the oscillator signal from the receiver was thought to have been substantially eliminated due to the fact that one or two vacuum tubes were interposed between the oscillator tube and the antenna circuit of the receiver. This, together with conventional shielding, was believed to be sufficient to prevent the radiation from being troublesome. Preselection was also thought to be the answer to preventing this radiation. As a matter of fact, the radiation of the oscillator was ignored inasmuch as it was not very strong and was considered to be a necessary evil. It was believed that it was suppressed as much as was possible, and since this rather weak signal very often did not fall in the broadcast band and did not cause serious interference with broadcast receivers, it was not considered important. Furthermore, it was of such low strength that the desired signals very often over-rode the interfering signal and it was unnoticed.*

*However, in the case of receiver operation in crowded apartment districts, several receivers may be coupled to the same antenna either directly or through some form of antenna current distribution system. In these events it has been found that in spite of the use of pre-selection in he various receivers there was still undesirable interference. Furthermore as the frequency was raised, the interference usually became stronger. This was particularly true in connection with operations on the short wave bands. For instance, in a specific case a receiver covering a range from 5.5 to 9.5 mc. (megacycles) was found to put out a signal of 20 m.v. (microvolts) at 5.5 mc. and 500 m.v. at 9.5 mc. at the antenna terminals; and in the range from 9.6 mc. to 15.6 mc. there was found to be a rise from 20 m.v. to 1000 m.v.*

*When a proper antenna match was provided for the receiver it was found that the receiver radiated quite efficiently and could be heard over considerable distance.*

*It becomes very desirable to limit this radiation under certain circumstances. This is particularly true for receivers which are used in marine communication for here the receiver is usually picking up signals that are weak and therefore the sensitivity of the receiver has to be greater than in the ordinary receiver such as is encountered in urban or city use.*

*It may happen that two separate receivers in close proximity are tuned to receive two different signals, one of these receivers which is tuned to a signal of exactly the signal desired to be received may also be tuned to the oscillator frequency of the other receiver. Very obviously if the interfering receiver oscillator generator signal was very strong, it would over-ride the desired signal or cause such interference as to prevent the desired reception in the other receiver. This might result in very serious consequences. In the case of marine reception it might be necessary that both of these signals be received and noted in the furtherance of life and security, and to say the least, this interference would be very annoying.*

*Still another and extremely important undesirable effect is apparent in times of war. A ship carrying valuable cargo, or personnel and under orders to maintain strict radio silence, even though its transmitters are shut down, becomes a potential broadcast station sending out signals from their receivers that may be picked up and used by enemy craft to guide them directly to their objective.*

*Therefore, it is one of the primary objects of this invention to provide a radio receiver wherein radiations of the receiver oscillator signal or other signals arising within the receiver are substantially, if not completely, eliminated.*

*Another object of the invention is the provision of an improved mechanical and electrical shielding structure in a receiver such that unwanted signals are eliminated.*

*Still another object of the invention and the invention itself becomes more apparent from the following description of an embodiment thereof, which is illustrated by the accompanying drawings and forms a part of this specification.*

*In the drawings:*

*Fig. 1 is a diagrammatic view of the antenna, radio frequency and oscillator compartments of a radio receiver having included therein an embodiment of the invention:*

*Fig. 2 is a sectional view through a receiver chassis illustrating certain structural features of my invention;*

*Fig. 3 is a top plan view thereof;*

*Fig. 4 is a bottom plan view thereof, only such parts being shown as are peculiarly applicable to the invention; and*

*Fig. 5 is a simplified circuit diagram of the radio frequency, oscillator and mixer stages of a receiver circuit embodying my invention.*

March 16, 1943. M. HOBBS 2,314,309

RADIO RECEIVER

Filed Feb. 2, 1942 3 Sheets-Sheet 1

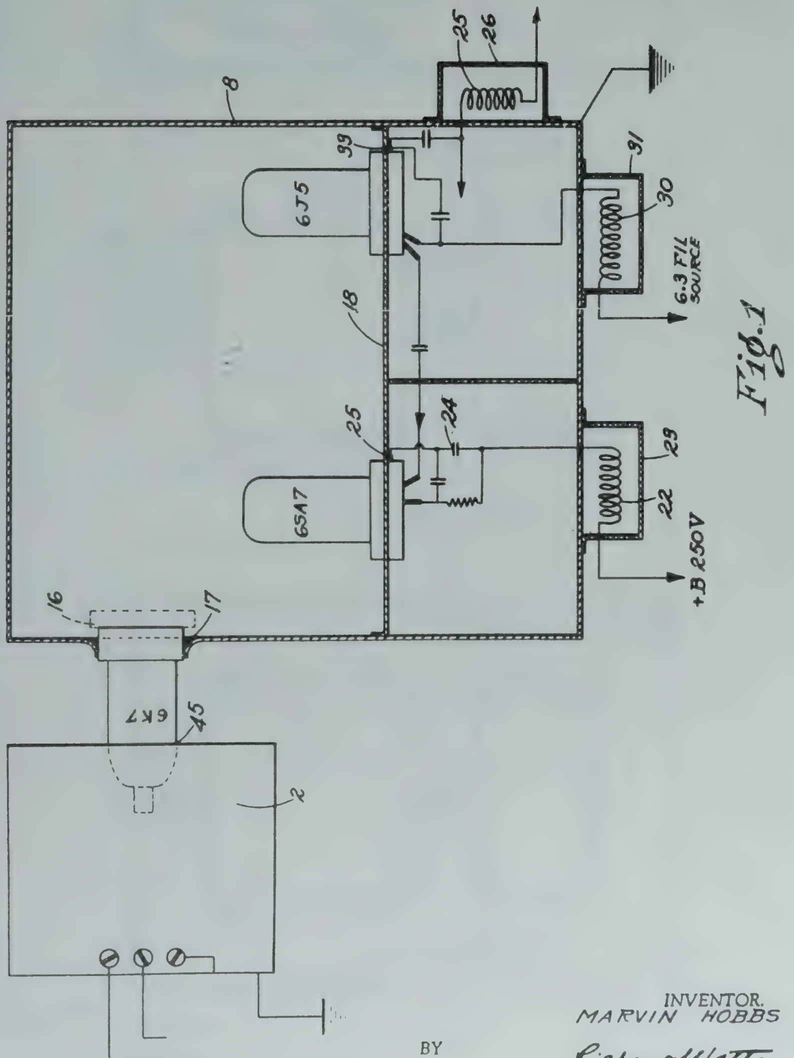



Fig. 1

INVENTOR.
MARVIN HOBBS

BY

Richey & Watts

ATTORNEYS

March 16, 1943. M. HOBBS 2,314,309

RADIO RECEIVER

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Fig. 2

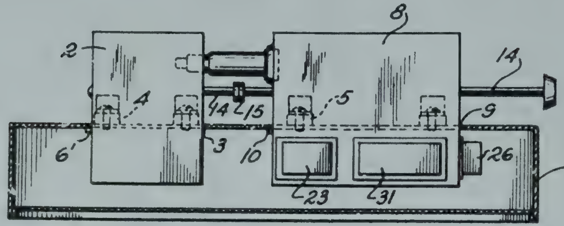


Fig. 3

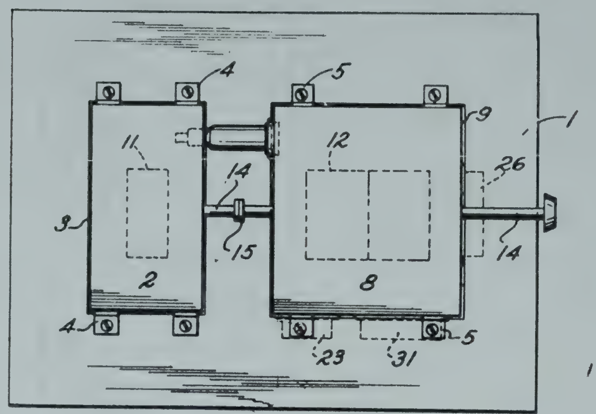
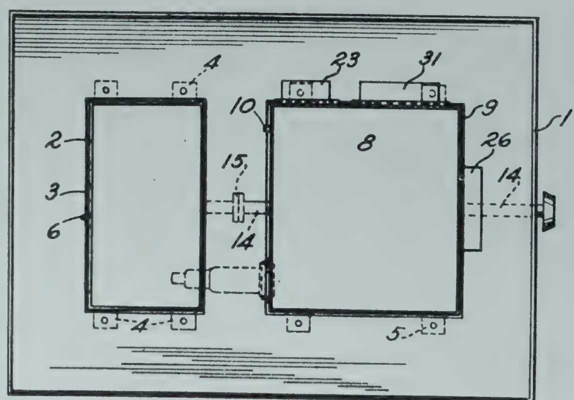


Fig. 4



INVENTOR.
MARVIN HOBBS

BY Richey & Watts

ATTORNEYS

**March 16, 1943.** **M. HOBBS** **2,314,309**

RADIO RECEIVER

Filed Feb. 2, 1942 3 Sheets-Sheet 3

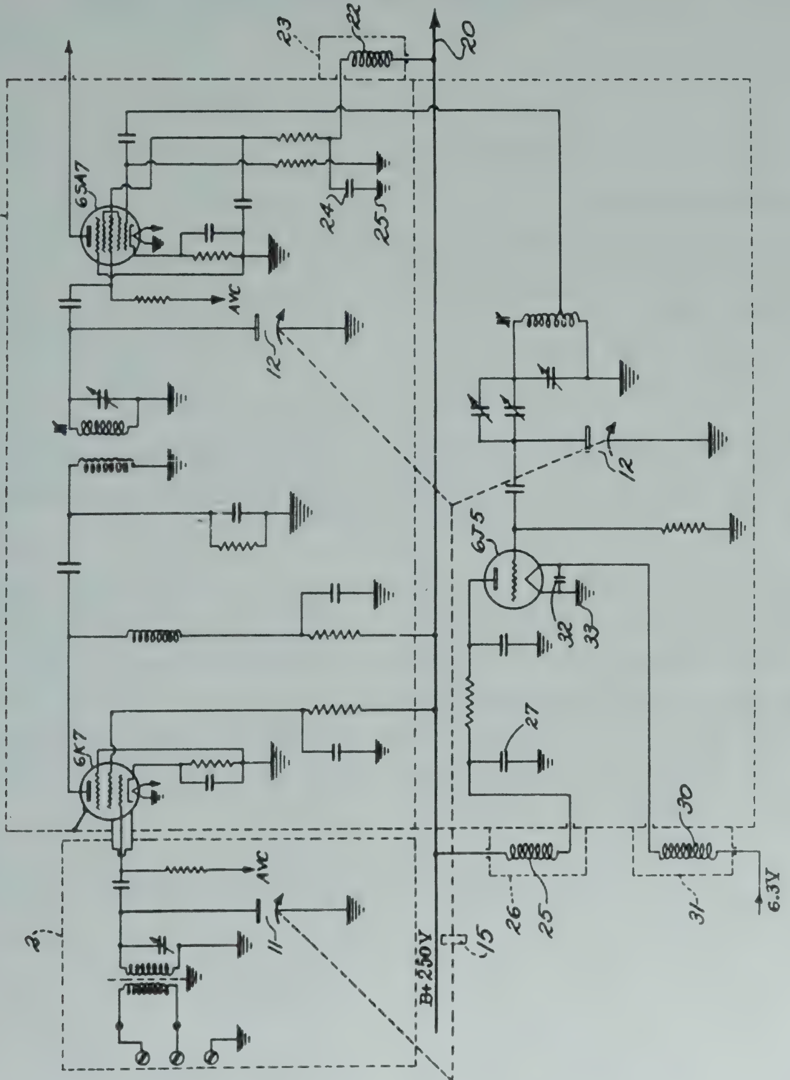



Fig. 5

INVENTOR
MARVIN HOBBS

BY Richey & Watts

ATTORNEYS

**BUREAU OF SHIPS**
**NAVY DEPARTMENT**
**WASHINGTON, D.C.**

February 1, 1947

Mr. Marvin Hobbs
E.H. Scott Radio Laboratories, Inc.
4450 N. Ravenswood Avenue
Chicago, Ill.

Dear Mr. Hobbs:

The Chief of the Bureau of Ships, in appreciation of your service to the United States Navy in World War II, takes great pleasure in presenting to you the enclosed Certificate of Commendation.

This award is made for your outstanding work as Chief Engineer of the E.H. Scott Radio Laboratories, Incorporated. Your excellent direction of the technical phases involved in the development of non-radiating receiving equipment and your personal contribution to the design and development of very high frequency shipboard crystal controlled communications receiving equipment, were of great benefit to the Naval electronics program.

Your contribution to the successful prosecution of the war is deserving of high praise.

Sincerely yours

E. W. Mills

Encl.

E. W. Mills
Vice Admiral, U.S.N.
Chief of Bureau

# Chapter 12
# Wartime at Scott Radio

The Scott receivers of World War II could be called a family. The various models had a common thread - patent #2,314,309 (titled "Radio Receiver"). All of the complete receivers incorporated this invention, which reduced oscillator radiation to a level which made it impossible for a submarine to receive enough signal to track a vessel containing one of these receivers.

The first member of this family was the morale receiver, RBO, developed in 1941. It would not have come into being unless its oscillator radiation was reduced to a level specified by the Naval Research Laboratory. When that was accomplished, the Navy Department ordered a considerable quantity of these sets. At least three were ordered for large vessels and one or more were ordered for smaller ships and naval craft. In the larger vessels, the three receivers were set in groups in the Radio room and their audio outputs were piped around to sailors' quarters, where three different programs could be selected ahead of a loudspeaker amplifier.

The initial orders for these Navy receivers were placed in 1941 just prior to the entry of the United States into the War. A little later the Maritime Commission became interested in such a receiver, but preferred to have a speaker incorporated into the unit. They also asked for AC/DC power. This resulted in the creation of the SLR-M model. The designation SLR was an abbreviation for Scott Low Radiation. M was for Maritime. Mr. Scott gave all of the low radiation morale receivers an SLR designation whether they were Maritime or Navy. As the War progressed the Navy Department made minor changes in their requirements for the RBO. The addition of a noise limiter and some minor component changes in the AVC circuit resulted in an RBO-1. A change in the audio output tube from a 6K6GT to a 6V6GT resulted in the RBO-2. Shortly after the Maritime Commission selected the SLR-M, the Navy decided that it also wanted a receiver with a built-in loudspeaker. This resulted in the REE model.

Although providing the broadcast receiver for the Navy and the Maritime Commission was an achievement in itself, the attention given to these applications tended to overshadow the contribution made to operational communications by other receivers in the family. By 1944 the Navy decided to turn the basic Scott low radiation design into a communications receiver. They ask for a set which omitted the broadcast band and replaced it with two long wave bands (80 to 220 kc) and (210 to 560 kc) and three shortwave bands, increasing the number of bands to five from the three bands of the RBO. The highest frequency covered was 26 mc, which was the top frequency of the Navy ship and shore communications transmitters. Actually, the shortwave coverage extended with overlap from just above the broadcast band to 26 mc. These features resulted in the RCH model. Providing for reception in the long wave bands, where at least a half a dozen ship and shore transmitters operated at power levels of 1 to 2 kw, as well as full coverage of the shortwave frequencies, definitely placed the RCH in the communications class.

The Navy has been very fond of long wave transmission for quite awhile. It enabled them to communicate worldwide from their U.S. base, especially with submarines. During World War I the first high power long wave station, NAA, at Arlington, Virginia was constructed and another at New Brunswick, New Jersey. In 1921 another station was activated at Jim Creek in the state of Washington. It had 280 miles of buried wire for its antenna. These stations broadcast in the 3 to 30 kc range (mostly in the audio band). The RCH did not tune this low in frequency, but received signals from several types of shipboard and shore-based transmitters operating below the broadcast band possibly in short range communications with submarines.

A receiver, which could tune down to 15 kc was the RBA, made by Federal. Its main function was to receive telegraph signals. It received speech with poor intelligibilty. In its broad selectivity, it cut off at about 1300 cycles of audio. This receiver was said to have

sufficiently low radiation to be operated during "radio silence." Radiation reduction was said to be provided by shielding within the equipment. The Navy considered the communication with nuclear submarines so important after World War II, that they proposed the construction of a number of extremely low frequency (ELF) stations in more recent years because such signals could penetrate deeper in the water to submerged submarines. You may recall the controversy, which was stirred up by environmentalists and others, who contended these high energy signals would be dangerous to the health of people living near the transmitting sites.

In another communications category the Navy had a transmitter model TDQ operating in the range of 115 to 156 mc designed for installation on ship or shore and primarily to provide communications with aircraft. They needed a receiver to work in combination with this transmitter. They chose to have a receiver model RCK to fill this requirement. This equipment had a plug-in preselector unit, which handled the signals up to the IF input. This preselector was designed with the low-radiation feature at the Scott Laboratories and the complete RCK receiver was produced there.

The RCK was part of a series of VHF and UHF equipment providing for the replacement of the 115 to 156 mc preselector with other preselectors that could extend the frequency range into the microwave region. Receivers with these preselectors were designated as the RDO. The preselectors above the frequency range of 115 to 156 mc were made by other companies and did not contain the low radiation feature. They were furnished to the Scott Labs to be installed in the remainder of the receiver, which was made at Scott.

The following are some excerpts from a letter from the Inspector of Naval Materials, USN to the Chief of the Bureau of Ships dated 16 April, 1943 relative to the nomination of the company for an Army-Navy E Award:

*"On October 15, 1941, the Naval Research Laboratories sent out a letter to the radio industry asking them to submit a design for a broadcast receiver in which the radiation was reduced to the point where it would not give away the position of the ship to an enemy submarine or surface craft. The Scott Research Laboratories designed and submitted a Low Radiation Allwave Scott receiver to the Navy on November 21, 1941, just 36 days later, which met both the Navy and FCC radiation standards. This model is now known as the RBO in the Navy. To date 3,798 receivers have been delivered to the Navy, and the company has a new contract from the Bureau of Ships to build another 2,000 receivers. According to the FCC bulletins published up to this time, sixteen months later, no other manufacturer has produced a Low Radiation Allwave broadcast receiver that has passed the FCC tests for safe operation at sea. In addition to building these Low Radiation receivers for the Navy, the company has also been given a contract, which it is now working on to build 2,650 Low Radiation Allwave broadcast receivers for the Maritime Commission for use on ships of the Merchant Marine.*

*As mentioned previously the RCH receiver was developed as a Low Radiation communications receiver for long and short wave reception. A version was also developed for the Maritime Commission. According to the Inspector's letter by April, 1943, the Bureau ofShips had ordered 1500, the Maritime Commission had ordered 1000 and the Signal Corps had ordered 500 for use on Army transports."*

The above statement by the Navy Inspector gives the impression that the RBO receiver was developed and submitted to the Navy within just 36 days. This is far from what happened. The sequence of conception of a morale receiver and its development extended from the Spring of 1941 to the Autumn of 1941. These are covered in detail in Chapter 12. The reason that Scott Labs had no competition when NRL issued its letter of October, 1941, was because no other company had conceived of a morale receiver or tried to reduce receiver radiation to the level required by NRL. An FCC release a year later showed that no other manufacturer had developed a receiver meeting NRL's requirements. It was around that time that an equivalent to the RBO was approved and contracted for from Scott Labs by the Maritime Commission as mentioned above.

Later the Navy Inspector stated:

"Some indication of the confidence of both the engineers of the Bureau of Ships and the engineers of the Naval Research Laboratories had in the engineering and production ability of this company is shown by the fact that the Bureau of Ships has just given a contract to build 700 ultra high frequency communications equipment. The engineers at the company in cooperation with the engineers at NRL are to complete the design of the preselector in this equipment, as well as to build the completed equipment."

The receiver referred to here was the RDO, which

tuned from 40 to 3400 MHz in search operations. It was not possible to cover such a wide range with a single r.f front end, so preselectors which could be interchanged when required were used. Those which covered the microwave range were supplied by another company, which specialized in handling these frequencies. The Scott Labs and NRL developed the preselector for the range below microwave freqencies and the remainder of the receiver, and Scott received a contract for the quantity indicated above. The RF preselector supplied by Scott Labs incorporated the low radiation feature.

According to the Navy Inspector by April 16, 1943 the company had received contracts of $5,599,910. These totaled $3,307,451 from the Navy, $1,534,546 from the Army, and $93,372 from the Maritime Commission. By February 29, 1944, the company held total contracts of $8,286,678, of which $7,482,053 was from the Navy, $796,814 from the Maritime Commission and $7,810 from the Army Signal Corps for parts.

Then he compared 1941 civilian production with 1942 wartime production as follows:

| 1941 CIVILIAN | 1942-WAR |
|---|---|
| $366,910 | $1,618,605 |
| 709 units | 5,130 units |


Low Radiation Broadcast Receivers

Three versions of these receivers were built. They all covered the broadcast band (530-1600 kc) and two shortwave bands (5.55-9.55 mc) and (9.20-15.60 mc).

These receivers were designated RBO, RBO-1, RBO-2. SLR-12, SLR-12A, SLR-12B. None of them incorporated loudspeakers, because they were designed primarily to be installed in groups of three in ship's radio rooms. They were tuned to three different frequencies and piped to crews' and sailors' quarters where three different programs could be selected from loudspeaker amplifiers. However, they could also be used with a separate loudspeaker or headphones with a maximum output of 2 watts.

Large numbers of these receivers were ordered by the Navy and they were installed on all Naval vessels.

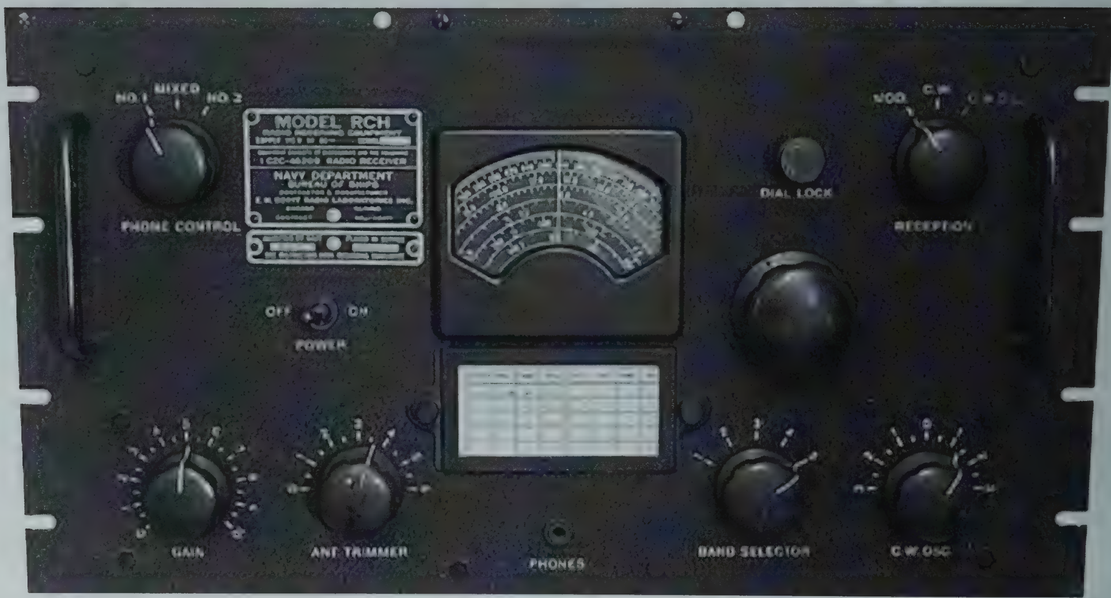
(Photo Courtesy of John Slusser Collection)


<u>Low Radiation Broadcast Receivers (continued)</u>

The Maritime Commission also adopted this type of basic design for merchant ships, but required a built-in loudspeaker and AC/DC operation. They tuned to four bands: 540-1600 kc, 1.35-3.58 mc, 3.4-8.8 mc, and 8.5-18.6 mc. The FCC set forth the radiation specifications for these receivers. This receiver was designated SLR-M.

The Navy then also requested a similar receiver. It was designated model REE.

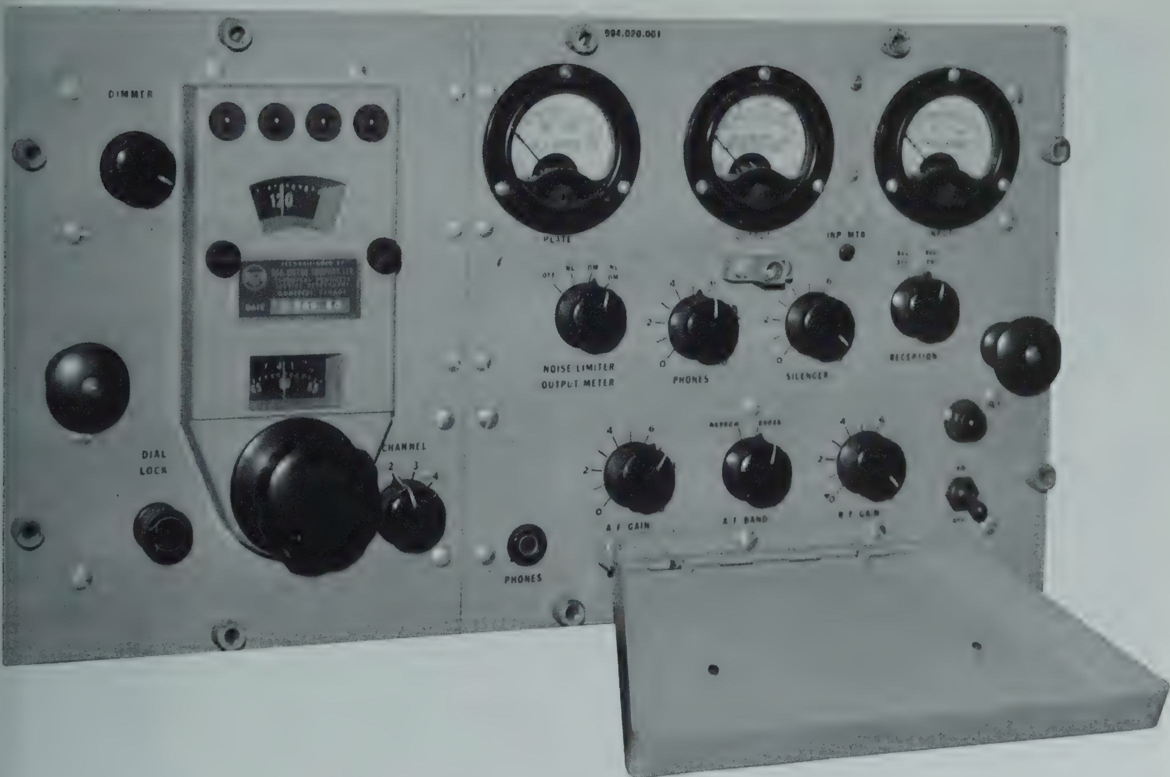
(Photo Courtesy of John Slusser Collection)




<u>Low Radiation Communications Receiver</u>

The Navy requested this type of basic receiver design as a communications receiver covering five bands, 80-220 kc, 210-560 kc, 1.9-5.1 mc, 4.5-12 mc, and 8.8-24 mc. Its use was ship-shore, CW, MCW and voice. It was used with a separate loudspeaker or headphones with a maximum audio output of 2 watts. This receiver was designated model RCH.

(Photo Courtesy of Max A. Kaplan)




Low Radiation VHF Receiver

The Navy requested this type of basic front-end receiver design for ship-shore operation with their TDQ transmitter in the 115-156 mc range. Its primary application was for communication with carrier-based aircraft. Four crystals could be installed for operation on any four channels within the 115-156 mc range. A single tuning control operating seven tuned circuits selected the channels. This receiver was designated model RCK.

This excellent and unmodified example of an RCK receiver (CZC-46222) S/N 2725 was acquired from a radio collector in Guelph, Ontario and then fitted aboard HMCS HAIDA Historic Naval Ship in June 1993. The receiver was originally accepted by the U.S. Navy on 11/8/44 and reconditioned by RCA Victor in Montreal on Nov 8, 1960. From the identification on the back of the placard, it was last used at the Quebec City, Quebec airport in the 1960's. Today, it monitors air traffic communications from Toronto Island Airport, Toronto and is only powered up weekly between May and September. The receiver is shown with its hinged control cover in the open position.

(Photo courtesy of Jerry Proc, VE3FAB, Radio Restoration Volunteer, HMCS HAIDA Historic Naval Ship, Toronto).

## Chapter 13

# Journey To Douglas and the Sacred Cow

### A Request from Donald Douglas

In late 1943, Donald Douglas, the President of Douglas Aircraft Company (since merged into McDonnell-Douglas, then Boeing) called from Santa Monica, California. He asked Mr. Scott if he could supply a radio receiver for the personal use of President Roosevelt to be installed in the first Presidential aircraft, to be known later as the Sacred Cow. Mr. Scott called me into his office to tell me that he had received such a request, and that I was to fly to Santa Monica to see what was required for such a radio with regard to specifications, installation, etc. Since we were still in the midst of a war, a priority was required to fly almost anywhere. However, I was soon advised that there would be no problem arranging for a priority and a ticket for my trip.

According to Air Force history, in the autumn of 1943, classified documents referring to a Project 51 were sent from Washington to the Douglas plant at Santa Monica. They directed the Douglas Aircraft Company to build for the USAAF, under contract No. 20284, a passenger transport aircraft intended primarily for use by the President of the United States. From the production line of C-54A-5-DOs, fuselage 78 bearing factory serial number 7470 was selected for Project 51. It was moved to a secluded and restricted area of the Douglas plant. When I arrived in Los Angeles, I was picked up by Douglas Personnel and taken by car to the plant, which as I recall was camouflaged to some extent especially at its entrance. From there I was taken to the secluded and restricted area of Project 51.

At this area I met Mr. Gibson, the interior designer of the plane, who after a brief discussion unfolded an artist's rendering showing a color sketch of FDR seated in his personal cabin of the plane. He had been drawn with the usual cigarette holder profile. The panels, table, and other furnishings to which the President would have access were shown. One of the panels available to the President controlled lights at various points and contained switches to enable the President to communicate through a telephone handset with the steward, radio operator, pilot and co-pilot as well as to the right and left forward compartments and the rear compartment of the plane. Oxygen equipment was close at hand behind a panel adjacent to that of the radio receiver. The compartment closest to the President was reserved for the radio control panel.

About all I was told was the dimensions of the control panel and the power available. After all, I could not expect an interior designer to provide much more, despite his cooperative attitude. With this information, I was to return to Chicago and deliver a radio within 30 days.

### A Radio for Roosevelt's Personal Airplane

Scott Radio Labs had not designed or built an aircraft radio before. True, we were building thousands of shipborne radio receivers meeting Navy specifications, but these were hardly something that one would expect to install in an airplane. Nevertheless, the time was too short to go into the development of an entirely new receiver with components of the type that were available for airborne radio equipment. After some discussion with Mr. Scott, I settled on a 17 tube superhet covering the frequency range of 150 KHz to 23.6MHz. The frequency range was divided into the regular broadcast band of 540 to 1550 KHz, three shortwave bands of 1.6 to 4.3 MHz, 3.5 to 9.9 MHz and 8.8 to 23.6 MHz and a long wave band of 150 to 400 KHz. The regular broadcast band and the three shortwave bands provided the signals which one would use for general listening purposes. The low frequency (or long wave band as it was often called then) provided primarily weather forecasts. Since these were transmitted in voice on the same channel as the A-N range signals used for navigational purposes, a filter was provided to reduce

**A View of the President's Chair and Communications Panel**
(U.S. Air Force Historical Collection, Courtesy Harry S. Truman Library)

the A-N code to the point where the voice transmissions could be understood without difficulty.

Because of the short time available to complete the receiver, we could not obtain rotary relays for remote switching, so I opted for flexible shafts to control the band and selectivity switching as well as the tuning, volume and tone. We certainly would have been better off with rotary relays for the switching, but the delivery schedule of the receiver appeared to be so rigid that we dared not request an extension in time. We built and tested the receiver and within the 30 day period delivered it to Douglas in Santa Monica. Once again I required a priority for the air travel, but this time we needed two priorities, one for me and one for the radio. I dared not check it as baggage. After the radio was delivered, I never saw it again except in photographs. We were not allowed to participate in the installation, which was done by Douglas personnel. At that time this work bore complete military classification as applied by the Air Force. We were not allowed to discuss it with anyone not cleared for classified material.

## The First Presidential Aircraft-The Sacred Cow

Many innovations were incorporated in the first presidential aircraft. The interior was arranged so that a specially designed collapsible chromium steel wheelchair for Mr. Roosevelt could be moved to all parts of the cabin. It was said that while flying, FDR preferred to sit in the cockpit between the two pilot's seats. To make this possible, a removable set of inclined rails was built on which the wheelchair could be rolled up to the cockpit floor level.

The President's private stateroom measured 7½ by 12 feet. Among its special furnishings was an upholstered swivel chair which was within easy reach of an oxygen mask, reading lights, a personal radio receiver (the Scott AR-1) and a telephone connecting with the pilot's compartment and three other compartments. A conference table was in the middle of this stateroom. On one side were four maps on rollers; four enlarged flying instruments including an airspeed indicator, altimeter, compass and clock; and a cabinet with an electric fan on top. At one end of the stateroom was a sofa, which could be electrically unfolded into a bunk. Another side of the room contained two electrically operated folding chairs, providing for a seating capacity of seven persons in this room.

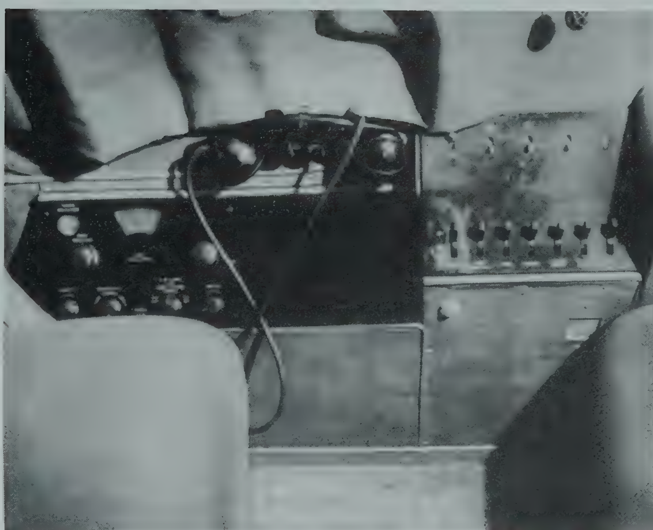
An additional feature of this section of the aircraft was a large bullet proof window. Since this window was the most distinctive exterior feature of this plane, an aluminum template was provided to fit over this window when needed. This template had cut within its center, a standard size window opening. Thus the aircraft could be given the typical C-54 appearance when required for security purposes. It is said that despite all of these precautions about the window, the surrounding skin of the aircraft could hardly have stopped an ice-pick.

All upholstery in the stateroom was blue worsted wool. The draperies were of blue gabardine on which was embroidered the insignia of the Army, Navy, Marine Corps and Coast Guard. In addition to the personal radio, which was considered to be a part of the plane's equipment but which was personally selected by Donald Douglas, he gave the President a painting by a fellow yachtsman, Duncan Gleason. It was an oil painting of the Bark Coriolanus, which had a colorful history, against the backdrop of the Azores. Donald Douglas gave this painting as a personal gift to the President and stated in a letter to him that it was not part of the aircraft's equipment and that it was provided at no cost to the government. This painting was hanging in the state room on one wall when the aircraft was delivered.

The aircraft could accommodate 15 passengers, sleep 6 and carried a crew of 17. A most unique feature of this airplane was that it contained a battery operated elevator, which could lift a passenger directly from the ground to the cabin-floor level. This elevator, located aft of the main passenger cabin, represented a security measure as well as a convenience. In the design of the first presidential aircraft, the president's need to walk with crutches or use a wheelchair was given special consideration. In the past it had been necessary to construct bulky ramps to aid FDR in embarking or debarking from an airplane. The very presence of such ramps at a foreign airfield would suggest his impending arrival. Of course, during World War II advance identification of the President as an incoming passenger at a foreign airfield was undesirable. The special elevator eliminated the need for telltale ramps.

When in the autumn of 1943 classified documents initiated work on the Presidential aircraft, they designated it as Project 51. However, Douglas Aircraft designated it as a C-54C, which was the only plane to ever carry that designation. Basically a C-54A, it had C-54 B wings with special ailerons that fit no other


**The Scott Radio Control Panel**



**The President's Communication Panel**

**The First Presidential Aircraft at an Army Air Base**
(Air Force Photo)

aircraft. It also had specially stressed landing gear doors. Despite the fact that it could carry only 15 passengers and a crew of 7, it emerged as one of the heaviest C-54s ever produced. For security reasons, it carried no non-standard markings and had the USAAF serial number 42-107451.

Although its official delivery date to the Army Air Force was listed as January 26, 1944, it was not until June 12, 1944 that Major Myers, who was then the President's pilot, flew the aircraft from Santa Monica to the National Airport in Washington, D.C. There it was assigned to the 503rd Army Air Force Base of the Air Transport Command. This aircraft may have been christened the "Flying White House" but everything about it was hush-hush at that time due to its highly classified status. Somehow it was given the name SACRED COW and became known as that the world over by interested observers. Official attempts were made to discourage the use of this name as "undignified" but to no avail. The name was never officially accepted, but its use by correspondents and others left little choice. Special insignia were designed for the plane, but were never adopted. The need for security during the war precluded its use. In fact, steps were generally taken to conceal its identity.

Less than a month after Major Myers flew the SACRED COW to Washington it flew on its first mission, but without President Roosevelt. On July 1, 1944, starting with its crew from Washington National Airport it flew Secretary of War Henry L. Stimson and his party from New York to Naples via Casablanca. The Casablanca to Naples flight was protected by strong fighter cover. On its return trip it flew the first non-stop flight from England to Washington covering 3800 miles in 17 hours and 50 minutes. Any flights that were made from that time until January, 1945, are not documented. However, early in 1945 one of its most historic ones was made.

While the SACRED COW waited for takeoff at Washington National Airport on January 21, 1945, one might have noted that its serial number had been changed from 42-107451 to 42-72252. This number was that of a C-54, which had been lost in the Pacific. The change was obviously for security reasons. At sunset on that date with only the crew aboard, the SACRED COW took off from National Airport and flew to Naples, Italy, arriving on January 24. At 7:05 AM on January 25, it took off for a dry run to the Russian airfield of Saki, some 60 miles from Yalta. It arrived there ahead of schedule and might have been shot down by Russian gunners if heavy weather had not given it some cover.

Since all went well on this trial run, the SACRED COW was returned to Malta to pickup a passenger travelling under thecode name of "Sawbuck"-otherwise known as Franklin D. Roosevelt. Taking off at 2:30 AM on February 3, 1945, FDR made his first flight in the SACRED COW from Malta to the Russian Airfield of Saki arriving at 9:10 AM. Actually, he had reached Malta by boat in the USS QUINCY. Exactly how FDR returned from Yalta is not documented except for a photograph of the SACRED COW with its substituted serial number sitting on an airfield near Cairo.

It is said that President Roosevelt was not greatly impressed with air travel. With other modes of travel he could be with people, which he liked very much. Air travel restricted this to some extent. Reports indicate that he made only three flying trips while in office. The first two were made in a seaplane, the DIXIE CLIPPER. The first trip was to Casablanca and the second one was to the Teheran Conference in November 1943 to confer with Stalin. These flights were made before the SACRED COW existed. His third and last flight to Yalta was the one mentioned above. Surprisingly, this was the only trip in which he used the SACRED COW-an airplane designed especially for him. However, it was to be used more by the President who followed him as well as others.

Exclusive use by the President was not the sole mission of this aircraft, or for that matter, any Presidential aircraft that has followed. It was not unusual that the SACRED COW carried members of the President's cabinet or other high ranking government officials travelling as direct representatives of the President. One such flight, carrying General Marshall and Secretary of State Byrne, was the first non-stop New York-Paris flight after that of Lindbergh. Many notable foreign passengers were listed in the aircraft log book. These included Winston Churchill, Mme. Chiang Kai-Shek, Dr. Benes of Czechslovakia and General Sikorski of Poland among many others. All were on important missions and all under the sponsorship of the President of the United States.

Following the death of President Roosevelt, President Truman made his first flight in the SACRED COW in a one–day round-trip between Washington and Kansas City on May 5, 1945. Subsequently, he used the SACRED COW for flights to the United Nations Charter Conference and for part of his trip to the Potsdam Conference. President Truman liked to fly and used the first

**Sacred Cow Landing at Saki, Crimea Carrying President Roosevelt to Meet Stalin at Yalta**
(Courtesy Franklin D. Roosevelt Library)

Presidential aircraft much more than his predecessor. Following Mr. Roosevelt's use of this aircraft, there was little requirement for the special elevator which it contained. However, it was not removed and on Mother's Day in 1946, it was used for the convenience of President Truman's mother in her flight from Kansas City to Washington.

Shortly following the end of World War II, the left side of the nose of the SACRED COW was adorned with the flags of 44 nations, which the aircraft had visited up to that time. By the time the Presidential flying duties terminated for this aircraft, a total of 51 flags had been applied. It has been recorded that the SACRED COW had flown over or visited 55 different countries during its tenure as the Chief Executive's airplane. (Many of the operational details of the Sacred Cow aircraft appeared in an article by Robert C. Mikesh in the American Aviation Historical Society Journal, Summer, 1963. They are given here with the permission of the Society.)

# Chapter 14

# Scott's Departure and the Aftermath

In all those years since World War I, Scott had not become an American citizen. I never knew his personal situation well enough to know just how he managed to do this. Nevertheless, in World War II, he was as patriotic as any American. He remained a citizen of New Zealand, but had a strong feeling for the British Empire and its struggle with Nazi Germany that was probably greater than many Americans had. After all, if England fell, the Empire would have been dealt a blow from which it would never have recovered even as a Commonwealth unless under Nazi direction.

Our effort at Scott Radio Laboratories during World War II must surely have made Scott happy. The fact that most of the Navy's and many of the Maritime Commission's ships were equipped with Scott radios must have heightened his expectations for post-war business. Nevertheless, he was very upset over the decision of the US Government's Renegotiation Board to allow him to keep only $79,000 of profit from sales of $2.8 million to the Navy in 1943. This profit was only 2.8 %, which does seem somewhat ridiculous. However, it was based on his pre-war volume of business and the profits which he made on it. No one was to be allowed to get rich from war business, so they said. Despite the great unseen publicity which the company was receiving during the war, Scott felt that profits of this magnitude did not leave him sufficient capital to take advantage of the consumer market after the war.

The legal counsel for the E.H. Scott Radio Laboratories was Emil N. Levin. Scott liked him personally and confided in him relative to the business as well as on legal matters. The law firm with which Levin was associated in the Chicago Loop also handled legal affairs for the New York Yankees baseball team and Dan Topping, their owner at that time. Such an association gave Levin quite a bit of prestige. He was also legal counsel for Harold Darr, a former aviator, who operated flight training schools under Air Force contracts during World War II.

## Scott Sells Company

In the first quarter of 1944, following the year when Scott had the unhappy feeling about the small profit to which he was limited on his governmental contracts, Levin brought Scott and Darr together to discuss the sale of E.H. Scott Radio Laboratories, Inc. to Harold Darr. The result was that Scott sold his ownership in the company, consisting of 6,000 shares to Darr and Levin for $260,000. This amount seems relatively small, but at the time, it was sufficient for Scott, who expected to continue as President of the company. He was only nearing the age of 57 and I am sure that he expected to travel quite a bit as he had done in the past.

In any event, 1944 was a relatively quiet year at the E.H. Scott Radio Laboratories, except for the building of the radio receiver for Roosevelt's plane. By this time, the company was well established as the supplier of the Navy's requirements for low radiation morale receivers and was beginning to play the same role for the Maritime Commission. That year, our main effort in marine morale receivers involved an AC-DC model complete with its own loudspeaker. In 1944 it was not apparent that there would not be any change in the management of the company. Apparently, the continuity was undisturbed because Darr and his associates were still busy with aviation schools. Perhaps, Scott was lulled into complacency as he planned a trip to New Zealand while the war was still in progress. Apparently, he arranged a priority, which was necessary for wartime travel, to go to New Zealand without difficulty. However, he had no assurance that a priority could be arranged for his return to the USA. So early in 1945, Scott left Chicago on what was billed as a trip to test our marine receivers at sea. As far as that goes, they were being tested by the Navy and Maritime Commission under such conditions, but I could see how tests made on this trip could be used in post-war advertising to help build back the consumer business of the company.

It appeared that Scott began to worry about what

might happen in the company while he was away, because within a month or so after he reached New Zealand, he contacted me to see if I could arrange a travel priority for his return. We had made several high level contacts in the Navy, so I tried to arrange such a priority at the highest level with Admiral Hull, who was then the head of the Bureau of Ships. He flatly refused to do so, contending that he had no basis for it. As far as he was concerned, Scott should not have gone in the first place.

Apparently, Darr went along with Scott's trip to New Zealand because he wanted to get him out of the country so that he could take over the company completely during his absence. As soon as Scott left, Darr converted the original 6,000 shares of the company into 251,850 shares at $1 par value and increased the authorized stock to 400,000 shares. Shortly thereafter, 225,000 shares were offered publicly at 3 1/8 through brokerage groups in Chicago. Darr and Levin sold 76,850 shares of their stock, netting them $240,156 in cash (less than $20,000 short of the amount they had paid Scott for the company). At the same time, they retained 175,000 shares to their account. Since the stock sold at more than $4 per share, within a short time, Darr and Levin had realized over a million dollars worth of cash and stock from their investment of $260,000.

## New Management Installed

Although I could not arrange a travel priority for Scott to return from New Zealand, he got back anyway in June of 1945. Upon his return he found that Darr had made himself President of the company, had appointed his executive, Frank Beiser, from the aviation schools to be the executive vice president, and had demoted Scott to share a position of vice president of sales and marketing with E.J. Halter, who had held that position for some time. Faced with all these developments, Scott resigned and took space in two Chicago newspapers, the Daily News and the Sun, to state his case of disagreement with the actions which had been taken with the company's stock. Considering Scott's demotion, it appeared that Darr expected him to leave the company.

While Scott was away, with Darr's permission I had agreed to serve as an Operations Research Analyst on communications for the Far East Air Forces in the Pacific Area for the remainder of the war on leave of absence from Scott Radio Labs. When I was about to leave, Darr was very unhappy about it, primarily because upon his return, Scott mentioned me in his newspaper interview and criticized Darr for giving me a leave of absence. Anyway, I went to the Pacific Area and did not return to Chicago until November, 1945. Despite my absence in the months immediately preceding the end of the war, I was welcomed back and got to work promptly on the development of the post war radio-phonograph model 800B. In the meantime, E.J. Halter had left and Joe Eliff, formerly with Stewart-Warner, had been hired as vice president of sales and marketing. I have to admit I was treated well and was expected to be part of the post war team. I wanted to see the company succeed, so I gave my best efforts to it.

Going into 1946, Darr boasted that the company had $800,000 in the bank largely due to the stock sale and that was much more than it ever had when Scott was there. We had an advertising budget of about a quarter million dollars which was handled through Leo Burnett's advertising agency. This amount resulted in the full page ads in Time magazine during 1946 and 1947. I went to New York City on trips to work with the famous industrial designer, Walter Dorwin Teague, on the styling design of the front panel and controls of the model 800B. All of this was good, but it reflected primarily the money in the bank. The real test of how well the company would fare in post war sales and profits was yet to come.

Although my responsibilities were the engineering and technical aspects of the business, I observed what I thought was a mistake in post war sales policy which may have led to the company's poor performance later. In the engineering role, I often had to make comparative listening tests between Scott receivers and those of competitors and to draw conclusions about customer preferences. Such experiences led me to conclude that a cardinal error was made in sales policy in the post war E.H. Scott era. With the company's added capital, it was reasoned that it should establish many more sales outlets after the war to increase the annual sales volume. An obvious way to do this was to sell through a large number of established dealers. In establishing this expanded sales activity, the best music store outlets in the country were selected and were anxious to have the product line. Stores like Marshall-Field had built separate rooms to demonstrate the Scott receiver. However, they also sold Magnavox, Stromberg-Carlson and other competitive brands. It was easy for prospective customers to move from one listening room to another, comparing prices and cabinet styles even if they had to

rely on their memory for comparison of the audio performance of the sets. Magnavox, in particular, benefited from this store situation. They had many more cabinet styles and models available. Their prices were lower than Scott on a much wider range of products. Scott sets in many cases probably brought the customer into the store, but after he listened in that salon for awhile he moved on to the Magnavox salon. With prices in the thousand dollar range for the best Scott radio-phonographs, sales suffered in such a comparative environment where many Magnavox sets could be bought at half the price. With Scott pre-war policy, sales were made only through his own private sales salons and by mail order. The prospective customer could not easily walk from the Scott products to competitive products making price comparisons. It is true that in theory sales would have been less over any given period, but the chances for survival would have been greater in my opinion.

Television was another area where the management felt that Scott had to develop a position after the war. Here another decision did not produce the best results. Since no work had been done on television receiver development at Scott, the only approach was to obtain a chassis from one of the principal producers. The post-war TV receiver market was moving so rapidly, it would have taken too long to develop new designs. In 1946, there were two principal producers--one was RCA and the other was Dumont. Since several companies were using the RCA 630 chassis, it was decided that Dumont was a better choice for a deluxe set. The decision was made to obtain a Dumont chassis with the largest picture tube available; which as I recall was either a 16" or 19" at that time. Actually, Scott could have made fantastic profits by adapting the RCA chassis to larger picture tubes even though other companies were doing the same. Dumont's chassis prices were too high to give Scott much competitive margin. When combined with radio-phonographs, the Dumont chassis brought the total price up to a point which limited sales.

Toward the end of 1946, I was interviewed by Avery Fisher in New York, for an engineering position, but about the same time I was also interviewed by RCA to be the chief engineer of their Berkshire line, which was to be developed during 1947. The opportunity with RCA looked too good to miss, so I chose it. However, my wife did not wish to move to the East Coast, so I arranged a consulting contract with RCA so I could handle the assignment but continue to reside in Chicago. I resigned from Scott Radio Labs, effective the end of 1946. Once again there was considerable unhappiness on the part of the Scott management with my leaving, but they went to the RCA License Labs or Hazeltine for recommendations for my successor.* They found Bill Cotter, who was the chief engineer of Stromberg Carlson.

Although I was gone from Scott from the end of 1946, I learned that they brought out TV models with the Philips projection system during 1947. The rapid development of large picture tubes with much sharper and brighter pictures soon rendered the dimmer projection system non-competitive. A radio-phonograph, designated model 16A, was also produced in 1947. Unfortunately, operations at Scott Labs were unprofitable from that year forward, and by 1949, sales declined to $604,900 for the year with a loss of $176,285.

## Meck and Scott Radio

In April 1950, John S. Meck acquired the Scott Radio Laboratories through the purchase of most of Harold Darr's stock and agreed to continue Scott's Chicago operations at 4541 North Ravenswood Avenue. Meck had been in business since World War II producing primarily private label radio and television sets in two factories in Northern Indiana. In purchasing control of the Scott Labs, he stated that it would operate separately from his lower-priced operations. In the June-August quarter of 1950, coinciding partially with Meck's purchase, sales exceeded $542,773. Gross profit for the quarter was expected to exceed $41,073. Sales rose from $79,000 in June to $300,000 in August. Most of this advance was accomplished by pushing Scott television sets aggressively through franchised dealers in competition with Dumont, Magnavox, Stromberg-Carlson, Zenith and others.

In March 1951, Meck announced his plans for what he called "limited editions" of Scott sets including models listing from $1,000 to $2,000. The emphasis continued on television and Meck said that the top price would go on a large screen TV-radio phono combination. It was said that a guarantee would be given that no other set like it would ever be sold in each city (apparently only one set per city). In July 1951, Meck introduced the top model of the line, a TV-Radio 3-speed phono combination with a 24"

**My assistant at Scott, Don Obenland, joined RCA early in 1947.*

picture tube. It was offered in a mahogany breakfront credenza cabinet, 68" wide, 38" high, and 24" deep, styled in 18th Century, French provincial or modern lines. Although the picture was smaller, this set was higher priced than Dumont's Royal Sovereign model, which had a 30" picture tube at $1,795.00.

In mid-1951, the new Scott Radio Laboratories looked good financially. Its net sales had risen to $2,775,795 for the fiscal year ending May 31 for a net profit of $167,811 or 40 cents a share. This performance contrasted with sales of $604,900 and a loss of $176,285 for the prior year, most of which was under the previous management. Of course, much of this result stemmed from the fact that Meck had plenty of TV models to which he could attach the Scott label. His objective was to exploit the Scott name to the fullest. By October 1951, Scott Labs looked so good to Meck that he decided to merge John Meck Industries into the Scott Radio Laboratories. The plan was for Scott Labs to absorb Meck Industries by issuing 1.3 shares of Scott stock for each share of Meck stock, with John Meck Industries surrendering its holding of 131,600 shares of Scott stock since April, 1950. By the end of October 1951, this merger had been approved by the Meck and Scott shareholders. The merger agreement contemplated an increase of Scott shares from 500,000 to 1,500,000 shares of which 1,006,185 would be outstanding as against 419,080 shares outstanding prior to that time. This merger became effective November 16, 1951. John Meck Industries then became a division of Scott Radio Laboratories.

During the next four years, the importance of a deluxe Scott image declined in the Meck scenario to the point where in January 1956, the Scott Radio (Meck TV) product line included 29 television models ranging from a 17" table model at $99.90 to a 24" consolette at $325. Sales for the prior fiscal year had been only $892,958 with a net loss of $191,110 versus sales of $2,143,235 and a loss of $263,370 for the previous year. John Meck decided to get out, so he sold the company to a group of West Coast industrialists headed by Benjamin B. Smith. Smith stated that the intention was to combine the Scott operations with those of a profitable company and manufacturing operation which would probably be centered on the West Coast due to the concentration of electronic development in that area. With the sale of the company, Meck resigned as President and Director. The West Coast company referred to above by Smith was the Monogram Mfg. Company of Culver City, California.

Although sold to Monogram Mfg. Company, Scott Radio Labs (also Meck TV) was still viewed as a separate entity and was placed in receivership in September, 1956, by the Federal Court in South Bend, Indiana, and the St. Joseph Bank and Trust Company of South Bend was appointed the receiver. Following this move, the assets of the company were sold in separate lots in a receiver's sale held on October 30 and 31, 1956. In one lot, the factory in Indiana went to Wagner Mfg. Co., Inc. of Wabash, Indiana, which was a manufacturer of electrically wired products for appliances and other products for the automotive and aircraft industries.

## The K-W Group, Liberty Music, and Scott-N.Y.

Another lot consisting of the goodwill and trade names of Scott Radio Laboratories, Inc. including copyrights, patents, trademarks and all engineering data, blueprints, drawings, and lists of customers together with the right to use the name 'Successors to Scott Radio Laboratories, Inc.' was also sold at that time. No inventory was included in that lot. Also the capital stock of the company was not sold, and after its discharge from bankruptcy in 1959, the Scott company resumed business under the name of Electrovision Corp.

The above lot was purchased for $8,000 by a group, consisting of Benjamin Kaye, Jerome Wiesenthal and Richard S. Wiesenthal. These individuals were referred to later in the H.H. Scott trial as the K-W group. They were the principal owners of the Liberty Music Shops, Inc., a large radio and television retailer with several branches in New York City and its suburbs at that time. The sale of this lot to the K-W group was approved by the referee in bankruptcy on November 2, 1956, and the trustee in bankruptcy executed a bill of sale to Liberty, which had actually put up the money. The bill of sale was delivered in March 1957, and the trademarks a month or two later. Liberty Music had sold the original Scott product line which was introduced following World War II and had been carrying the H.H. Scott line of high fidelity components for some time, as well as most of the well-known brands of the high fidelity industry, including Stromberg-Carlson and Magnavox. Later in 1957, the K-W group organized a New York Corporation named Scott High Fidelity Laboratories, Inc. (later referred to as Scott-N.Y. in the H.H. Scott trial) and on May 25, 1957, Liberty Music, acting as an agent for the

K-W group, executed an assignment of the original Scott assets purchased to the above Corporation. Shortly thereafter, this combination arranged to assemble and sell a line of radio-phonograph consoles carrying the original Scott name to be sold exclusively through Liberty's retail stores in Metropolitan New York.

In the autumn of 1957, they introduced a 1958 series of these Scott instruments, referring to them as distinguished phonograph-radios in Decorator Design cabinets. They used a Scott trademark, which had been registered in 1948 by the Scott Radio Laboratories of Chicago and which had appeared on the dial of the Model 800B. In their advertising, they followed this Scott name by the statement "The Oldest Name in Hi-Fi." Top FM-AM models included the GE magnetic reluctance phonograph pickup, a 4-speaker system with built-in crossover network in a sealed compartment, an amplifier with a 20 to 20,000 cycle frequency response and 35 watts peak output, separate bass and treble controls and a record compensator with full equalization. From 1958 to 1960, Liberty Music continued to introduce Scott product lines ranging from high fidelity radio-phonographs to stereo radio-phono TV combinations. This activity reached a climax during the autumn of 1959 when ten models ranging in price from $549.95 to $1495.00 were advertised. Following that, they introduced a component stereo line under the same label. In the later legal action by H.H. Scott, it was contended that all of the radio chassis used in these sets were purchased from known radio manufacturers and were generally selected from their cheap line. Of course, it was well known that Liberty Music or its associates did not make the cabinets which housed these sets and record changers. They were undoubtedly of good quality and appearance to make the products saleable.

## Annapolis Electroacoustic Corporation

While all of this activity was going on at Liberty Music, a new player in the scene was developing in Annapolis, Maryland. There in October, 1958, a company known as the Annapolis Electroacoustic Corporation was organized by a group associated with the Chesapeake Instrument Corporation, a company specializing in research and development of electroacoustic devices for the government. This group was originally engaged in the sale of high fidelity products at retail in Annapolis, Maryland, but in 1959 decided to enter the field of manufacturing audio reproduction equipment. A former manager of consumer products for the Stromberg-Carlson Company, Leon Knize,became associated with them. He suggested that the Annapolis company could enter the market more rapidly and inexpensively if it had a name that was already known and suggested that the original Scott name and trademarks might be available. The Chesapeake group thought that if a trademark of that type could be acquired for less than the cost of creating a comparable image for Annapolis through extensive advertising, it should be done. Leon Knize was authorized to look into the matter and at that point approached the K-W group.

After negotiations, the Annapolis group entered into an agreement with the K-W group, as owners of all the outstanding shares of Scott-NY, dated July 25, 1960. This agreement provided for the sale of all the capital stock of Scott-NY by the K-W group to Annapolis for $255,000, payable $15,000 on August 3, 1960; $15,000 on November 1, 1960, and the balance in quarterly installments on a basis of one percent of the net sales, with stipulated minimum quarterly payments and a requirement that the full balance be paid by March 1, 1969. As a further consideration of the sale of the stock, the K-W group obtained 5,000 shares of the stock of Annapolis and options for 2,500 more. In this transaction only the corporate shell as owner of the trademarks passed to the new owner of the stock. No employees, equipment, blueprints, engineering or specifications went along. The entire inventory of Scott-NY which consisted of radio-phonographs in various models, had been transferred to Liberty Music.

A separate agreement, also dated July 25, 1960, provided that Liberty should dispose of this inventory by March 1, 1961, or by the date of the first shipment of "Annapolis Scott" products, whichever was later. This part of the agreement led to the offering of many Scott models at discounts of 20% to 50% in Liberty Music's "Only Sale of the Year" in January 1961. If the inventory was not disposed of by the later of the two dates, the parties would renegotiate with respect to the disposition of the merchandise so that Liberty would not take a loss on it. By the same marketing agreement, Liberty was designated the exclusive franchisee in New York of the products manufactured by Scott-NY, now controlled by Annapolis, as long as it took a fixed percentage of the output of that corporation. Shortly thereafter, Annapolis, as sole stockholder of Scott-NY, had the name of that corporation changed to "Scott Radio Laboratories, Inc.,"

exact name of the original Illinois corporation at the time of its bankruptcy. In the H.H. Scott trial it was said that this was done because the Annapolis group "wanted to tell the public that Annapolis was the Illinois company," and they said they wanted "to be and continue the good reputation and quality of the corporation."

The Annapolis group wrote a letter to dealers saying "The first thing we did was to purchase the assets of Scott Laboratories of Chicago. We will operate Scott Laboratories as a division of Annapolis Electroacoustic Corp. and Scott will be our brand name." On December 4,1960 Annapolis and Liberty Music placed an advertisement in the New York Times stating that Scott-NY's products as being made by "the original Scott producers of high fidelity equipment for thirty-four years." In the autumn of 1960, Scott-NY, under the direction of the Annapolis group, brought out its first product, which was advertised as a high quality revolutionary speaker system, which was to be sold under the original Scott name and mark by Liberty Music in the metropolitan New York market and by some dealers elsewhere. This move undoubtedly provoked H.H. Scott considerably because he was about to introduce two new loudspeaker models of his own design. Like many other electronic engineers, he had concluded that the loudspeaker was the bottleneck in perfect reproduction of high fidelity sound and was proceeding to do something about it.

## H.H. Scott, Inc. vs. Annapolis Electroacoustic Corporation and Scott Radio Laboratories, Inc.

H.H. Scott learned of the retail sales of radio-phonographs under the original Scott label by Liberty Music in September 1957. However, since Liberty was then a large dealer in his components, since H.H. Scott thought that Liberty had acquired the use of the mark in that way in an incontestable manner, and since Liberty had assured him that it would make every effort to avoid confusion, he took no action to prevent such use of the mark by Scott-NY or by Liberty Music, and continued to sell his components to Liberty. In 1959, as mentioned above, the K-W group, Liberty and Scott-NY caused to be manufactured and sold in the Liberty retail stores some high fidelity components (separate tuners, amplifiers, etc.) under the original Scott label. When H.H. Scott learned that Liberty was selling these components under that name, he immediately ceased doing business with Liberty and began to consider the desirability of legal action. However, legal action was not taken by H.H. Scott until the Annapolis Electroacoustic Corporation had acquired Scott–NY and changed its name to Scott Radio Laboratories in 1960. I knew Hermon Hosmer Scott personally and he asked me to be a witness at the trial, and, of course, hoped that my testimony would help his cause. He kept in touch with me, but I was sent to the West Coast on a trip by the company for whom I was working at the time the trial was scheduled. So I was not there as a witness.

The trial was held during the first half of 1961 in the United States District Court in Maryland. During the trial, various points were brought out for the plaintiff and the defendants. Although favorable points relative to H.H. Scott, Inc. were made, it appeared that the unfavorable points relative to the way in which the K-W group and Liberty Music had handled whatever assets they had prior to their sale to the Annapolis Electroacoustic Corp. carried the most weight in the final decision of the court. Some favorable points made for H.H. Scott, Inc. were as follows:

1. If high fidelity was defined in terms of separate tuners, amplifiers and loudspeakers, H.H. Scott had been an innovator in this approach.

2. H.H. Scott, Inc. had spent considerable amounts on national advertising from 1957 to 1960 while Liberty Music was strictly a local affair in New York City. The following negative points were made relative to the K-W group and Liberty Music:

1. The K-W group did not buy the trademarks, the good will, etc. from the trustee in bankruptcy with any intention of continuing the business of the original Scott company. They were not interested in any part of its purchase except the Scott trademarks and good will associated therewith. They used none of the other trademarks, and none of the patents or customers' lists; they discarded the blueprints and engineering data and junked the tools and dies.

2. Since the K-W group and their two corporations used the marks only in connection with the retail business of Liberty Music in metropolitan New York and did this for more than two years, it could be considered that they abandoned the mark nationally.

3. It was contended that during the period of 1957 to 1960, while both Scott-NY and Liberty Music were controlled by the K-W group, they used the marks so as to misrepresent the source of goods and services in

connection with which the marks were used. It was contended that in various ways in detailed findings that they attempted to persuade and persuaded prospective purchasers to believe that (a) the components in the consoles which they were selling under the original Scott name and mark, and (b) the other components which they began to sell in 1959 under the original Scott name and mark, were the product of the plaintiff, H.H. Scott, Inc. It was claimed that under the Lanham Act this was ground for cancellation of the registration of the mark, even though it might be otherwise incontestable.

4. Thus, the question could be raised whether the Annapolis group had really acquired anything through their deal with the K-W group.

Taking into account these points and related testimony, the District Court handed down its decision on June 16, 1961, that the defendants Annapolis Electroacoustic Corporation and Scott Radio Laboratories, Inc., their agents, servants, employees and all persons acting in concert with them be and they are hereby personally restrained and enjoined in connection with the sale, manufacture, distribution, or marketing of radio wave apparatus, record players, and any and all audio-reproducing equipment, from directly or indirectly advertising, displaying, affixing, or otherwise using or referring to the trademark or trade name SCOTT and any and all variations, combinations, or colorable imitations thereof. Interim provisions were made for the sale of existing inventory over a period of seven months and fifteen days. The defendants were further barred from representing any of their goods as being products of H.H. Scott, Inc. All of the trademarks which the K-W group had acquired through their purchase of the bankrupt assets were ordered cancelled and the defendant Scott Radio Laboratories, Inc. was ordered to change its corporate name within forty-five days.

In retrospect, it appears that if any purchaser of bankrupt assets had continued the business nationally and had not taken the approach of the K-W group and Liberty Music, it would not have been possible for H.H. Scott to have done anything about it. Nevertheless, this court action assured that from the early 1960's, the only Scott Radio audio products would emanate from H.H. Scott's operations in Massachusetts.

## H.H. Scott and High Fidelity

As I mentioned above, I knew him personally from 1946 onward. With a technical degree from MIT, he worked as an engineer for the General Radio Company near Boston for a period of about 15 years prior to that date. Aside from his contributions to General Radio products, which were primarily test instruments, he had applied for patents on a record scratch noise suppressor, which was somewhat more elaborate than the "variable tone control" type used in the E.H. Scott Philharmonic, Phantom, or other E.H. Scott models. H.H. Scott's noise suppressor employed filters and gates to give sharper noise cutoff characteristics on the fidelity curves at low as well as high frequencies. Presumably one would hear a clearer high fidelity sound with less noise than with the type used in the E.H. Scott receivers.

In 1946, Harold Darr, then President of Scott Radio Labs in Chicago, decided it would be a good idea to license under H.H. Scott's record noise suppressor and related patents, five of which were granted during January and February 1946. I thought that the H.H. Scott noise suppressor worked a little better than the suppressor used in the earlier E.H. Scott sets but I wondered if it was worth the complication and expense. However, I thought that Darr just wanted a technical agreement with another Scott since E.H. Scott was no longer around the Laboratories. As I recall, Fisher Radio Corporation also took a license with H.H. Scott on his patents and there were probably others whom I do not recall. At the 1947 National Electronics Conference in Chicago, H.H. Scott gave a paper in which he discussed a 10-tube broadcast station version of his noise suppressor system and stated that it was used by both AM and FM stations. Also, he showed the circuit of a 2-tube version which he said was being built into home radio-phonographs. In all fairness, he mentioned that the automatic tone control type of noise reduction system was used for several years in pre-war receivers manufactured by the E.H. Scott Radio Laboratories.

In addition to his efforts to sell licenses for the manufacture of his noise suppressors, H.H. Scott manufactured both broadcast station and home hi-fi type noise suppressors as his first products. 1947 marked the dawn of the component high fidelity era (separate tuners and amplifiers). H.H. Scott was there at the right time. During the decade of the 1950's, his company became one of the largest manufacturers of separate high fidelity tuners and amplifiers. Fisher Radio was his chief rival, with more of its business at the time in units housed in console cabinets. H.H. Scott was said to be the first to incorporate automatic variable bandwidth in the AM tuners, a pioneer in the use of

transistors in audio equipment, the first to use integrated circuits and field effect transistors and also the first to incorporate MOSFETs (field effect transistors) into tuner front end design.

Two factors were said to have contributed to the decline of the H.H. Scott company in the 1960's. One was the problems which were encountered in the transition from tubes to transistors. H.H. Scott jumped in the transistor direction quickly and was soon more heavily committed to transistors than his competitors. It was rumored that on some H.H. Scott models, the return rate from the field was as high as 25%. The second factor was the shift in manufacturing from the USA to Japan. By the late 1960's, most of the US high fidelity and stereo brands were being made in Japan and shipped here as private label items. H.H. Scott steadfastly refused to make this shift and by the late 1960's both the company and H.H. Scott were very ill. Both of the above factors continued to plague the company and in 1971 he sold it to Eastern Air Devices (EAD), whose management did nothing at all to halt the deterioration of the company. In 1973, EAD sold the H.H. Scott company to a foreign holding company, Blubel International. The company operated in new quarters in Woburn, Massachusetts, offering a line of high fidelity receivers, amplifiers, tuners, cassette tape decks, turntables and loudspeakers. Most of these products were made overseas, but the loudspeakers were made for awhile in a plant in Massachusetts. Hermon Hosmer Scott died in 1975 at the age of 65. Then, the H.H. Scott brand was acquired by Emerson Radio Company.

Perhaps ironically E.H. Scott, McMurdo Silver and H.H. Scott all passed away as disillusioned businessmen, while the least technical one, Avery Fisher, sold his company to the Emerson Electric Company for millions. Today, Fisher is part of Sanyo Electric of Japan.

# Chapter 15
# The RCA Berkshire

During the 1930s, the U.S. Patent Office celebrated its Centennial. Mr. Scott was invited to demonstrate the high fidelity performance of one of his receivers as part of this celebration. He chose to do so with the Philharmonic. Many executives and engineers of other companies were present at this demonstration. One of them was David Sarnoff, Chairman of the Board of RCA. During the demonstration he was overheard to remark "why can't we do something like this ?".

In 1946, Frank Folsom, then with Montgomery Ward, was brought into RCA as President. He brought with him a lady, Harriet Higginson, to head a Consumer Custom Products Department. She sought to develop a line of receiver products that could provide an answer to the question raised by Mr. Sarnoff mentioned above. The first step was to seek engineering support within RCA for such an effort.

At that time RCA's Consumer Product development was done at its headquarters in Camden, New Jersey. In 1946 and 1947, their engineering department was very busy with the development of a line of television receivers and engineering management did not wish to divert its efforts to the design and development of other products. David Cole, who was in charge of television receiver development, was so attached to that program that his signature appeared on the nameplate of most RCA television sets. So, Harriett Higginson had no alternative,but to seek engineering support outside of Camden.

One of the places to look for such talent was Scott Radio Labs. By the end of 1946, I had become somewhat disenchanted with the new management. I liked Harold Darr, but he kept his office downtown in Chicago and delegated day-to-day management to a person who did not reflect his personality. So when I was offered the opportunity to join RCA, I thought that I should accept it. I resigned from Scott Radio late in 1946 and joined RCA early in 1947, as mentioned in the previous chapter.

Since their engineering department in Camden did not wish to handle the development of a line of consumer custom radio receivers, it became my responsibility to find a company outside of RCA with which I could work to realize the desired results. I worked out a consulting arrangement rather than employment by RCA.

I knew of a small company in River Forest, Illinois (a suburb of Chicago), which had the engineering capability to develop the models and the production as well. That company, ARF Products, had been developing and producing equipment for the Signal Corps. Since it did not have to market these consumer products, their capabilities appeared to be adequate. That company had two capable engineers, John Pakan and Richard Goldstein. Under my direction they developed and built a model of the radio receiver to become known as the RCA Berkshire. While this was progressing, I arranged for Don Obenland, who had been my assistant at Scott to join RCA at Camden as a direct employee so that we could maintain uniformity with RCA's product documentation and service procedures.

## Reproduced Sound vs Live Sound

Harriett Higginson and top management at RCA decided that something dramatic should be done to launch the marketing program. It was thought that a demonstration something similar to the one which Mr. Scott gave at the Patent Office Centennial should be arranged. However, this event was to be more dramatic in that the output of the radio receiver and its loudspeakers was to be compared with that of a live symphony orchestra. Such a demonstration was arranged at Tanglewood, Massachusetts, where Leonard Bernstein was conducting the Boston Symphony Orchestra.

On July 29, 1947, such a comparison was made in the Shed at Tanglewood. The Shed is an immense structure where musical presentations are given regularly on a seasonal basis. It is 239 feet long, 200

feet wide at the rear and 40 feet high with seating for 6,000 listeners. A record was made of a selection played by the Boston Symphony Orchestra (needless to say, on the best vinyl platter that RCA had available). The receiver connected with 12 dual cone loudspeakers (known as the RCA Olson high fidelity type), suitably housed for this type of auditorium was placed in front of the stage for reproduction.

In the demonstration the orchestra played the first portion of the selection, then suddenly stopped playing, and the remainder of the selection was reproduced from the record. Dozens of music critics, who had been invited from across the country, stated that they could not tell when the live orchestra left off and the reproduced sound began. This demonstration was so successful that, is was decided to name the radio the "Berkshire", because Tanglewood was located in the Berkshire area in Western Massachusetts.

## The Receivers and the Cabinets

In the meantime, RCA had given ARF Products an order for 500 Berkshire radios and had placed orders for 500 cabinets with manufacturers in South Carolina. Five cabinet styles had been ordered. One of them, called the "Breakfront" housed the radio receiver, record players, loudspeaker, and a projection television receiver. The other four housed the radio receiver, record players and the loudspeaker. They were called the "Secretary", "Regency", the "Modern" and the "Contemporary".

I do not recall whether there were any problems with the delivery of the cabinets. However, the management at ARF Products had a habit of underestimating development costs. This probably stemmed from the fact that all of their previous work had been done under government contracts. Overruns of costs are quite common among defense contractors, who in many cases go back to the government for additional funds, which are almost always provided. With consumer products, price increases over short cycles are not acceptable. However ARF Products sought price increases, which RCA had to absorb. As I recall they may have been given a second contract for 500 receivers, but it was cancelled because of their demand for higher prices. The Consumer Custom Products Department, which handled the marketing of the Berkshire,was hampered by price increases to such an extent that it became unprofitable and was discontinued in 1948. As mentioned above, the engineering department in Camden had not wished to be involved with it and engineering management had voiced opposition to it. They finally had their way with top management.

## Staying in High Fidelity

However, RCA had a real disciple of high fidelity in their Research Laboratories at Princeton, New Jersey. Dr. Harry F. Olson and his assistant, John Preston had developed and patented versions of a dual cone loudspeaker, which was labeled the LC-1A. Earlier versions of this loudspeaker had been used in the cabinets of the Berkshire series. Since 1946 he had given many demonstrations of high fidelity in what he called the Living Room Laboratory, designed to simulate the acoustics of the living room in the average house. As a result he had modified the design of the LC-1A speaker to obtain better sound distribution.

As a result, RCA continued with a high fidelity product line of components, consisting of tuners, preamplifier, main amplifier, record changer and the LC-1A loudspeaker. Camden accepted this continuation under the title of RCA Engineering Products Department. Don Obenland, whom I had placed in Camden, handled the development of these products. However, the furniture aspect of cabinetry was abandoned and these components were offered in very ordinary cabinets. Of course, they could be purchased as components and installed in whatever cabinet the owner chose to place them.

Since then RCA abandoned all engineering operations at Camden and moved them to Indianapolis, Indiana. Now all products bearing the RCA label are made by other companies and are imported.

# RCA VICTOR

# BERKSHIRE

## AM-FM Radio Tuner Unit TU-1

## Phonograph Pre-Amplifier Unit PPAU-1

## Audio Amplifier & Power Supply Unit AAPU-1

# SERVICE DATA

— 1948 . . . No. CCP-2 —

**RADIO CORPORATION OF AMERICA**
CONSUMER CUSTOM PRODUCTS DEPT.
RCA VICTOR DIVISION
745 FIFTH AVE., NEW YORK 22, N. Y.

PH292

## Electrical and Mechanical Specifications

The Berkshire receiver chassis consists of dual channel superheterodyne tuners for high quality AM and FM reception and a wide range audio amplifier with provision for input from radio, television and phonograph audio channels. It incorporates 33 tubes (30 receiving types, 2 power rectifiers and 1 voltage regulator) and two meters for AM and FM tuning indication. A single tube pre-amplifier is provided to furnish adequate gain and compensation for the low level magnetic reluctance phonograph pickup. Output voltage is delivered through a transformer matching to 15 ohms. More than one loudspeaker may be accommodated by the proper combination of load resistors with the speaker load.

The receiving equipment consists of the following major components:

1 — AM and FM Tuner Chassis
1 — Audio and Power Supply Chassis
1 — Phonograph Pre-Amplifier Chassis
1 — Built-in Antenna System

### Frequency Range

| | |
|---|---|
| Broadcast ("A" Band) | 540-1625 kc. |
| Shortwave 1 | 1.590- 4.050 mc. |
| Shortwave 2 | 3.950- 9.500 mc. |
| Shortwave 3 | 9.450-11.750 mc. |
| Shortwave 4 | 11.670-15.200 mc. |
| Shortwave 5 | 15.080-17.750 mc. |
| Shortwave 6 | 17.680-21.500 mc. |
| Shortwave 7 | 21.400-22.500 mc. |
| Frequency Modulation (FM) | 88-108 mc. |

The coverage is such that electrical spread band is provided for the 13, 16, 19, 25 and 31 meter shortwave bands. Full coverage is provided on all shortwave bands up to 22.5 mc.

### Intermediate Frequency

| | |
|---|---|
| Broadcast | 455 kc. |
| Frequency Modulation | 10.7 mc. |

### Tube Complement

| | | |
|---|---|---|
| 1. | RCA 6BA6 (V16) | 1st R-F, AM |
| 2. | RCA 6BA6 (V17) | 2nd R-F, AM |
| 3. | RCA 6BE6 (V18) | Converter, AM |
| 4. | RCA 6C4 (V19) | Oscillator, AM |
| 5. | RCA 6BA6 (V20) | 1st I-F, AM |
| 6. | RCA 6BA6 (V21) | 2nd I-F, AM |
| 7. | RCA 6BA6 (V22) | 3rd I-F, AM |
| 8. | RCA 6AL5 (V23) | 2nd Det. and Noise Limiter, AM |
| 9. | RCA 6AK5 (V1) | 1st R-F, FM |
| 10. | RCA 6AK5 (V2) | 2nd R-F, FM |
| 11. | RCA 6AK5 (V3) | Converter, FM |
| 12. | RCA 6J6 (V5) | Oscillator, FM |
| 13. | RCA 6AU6 (V4) | A.F.C., FM |
| 14. | RCA 6BA6 (V6) | 1st I-F, FM |
| 15. | RCA 6BA6 (V7) | 2nd I-F, FM |
| 16. | RCA 6BA6 (V8) | 3rd I-F, FM |
| 17. | RCA 6BA6 (V9) | 4th I-F and Driver, FM |
| 18. | RCA 6AL5 (V10) | Ratio Detector |
| 19. | RCA 6J6 (V11) | Tuning Indicator Amp., FM |
| 20. | RCA 6SL7GT (V301) | Phono Pre-Amplifier |
| 21. | RCA 6C4 (V12) | Pre-Amplifier (Audio) |
| 22. | RCA 12AU7 (V13) | Audio Filter |
| 23. | RCA 6C4 (V14) | Audio Mixer |
| 24. | RCA 6C4 (V15) | 1st Audio Amplifier (Tone Control) |
| 25. | RCA 6SQ7 (V401) | 2nd Audio Amplifier |
| 26. | RCA 6J5 (V402) | Phase Inverter |
| 27. | RCA 6L6G (V403) | Audio Output |
| 28. | RCA 6L6G (V404) | Audio Output |
| 29. | RCA 5L6G (V405) | Audio Output |
| 30. | RCA 6L6G (V406) | Audio Output |
| 31. | RCA 5U4G (V408) | Rectifiers |
| 32. | RCA 5U4G (V409) | Rectifiers |
| 33. | RCA VR150 (V407) | Voltage Regulator |



First Edition, First Printing

Printed in U. S. A.

## The AM Section

The AM tuner channel consists of two tuned R-F stages, pentagrid mixer with a separate triode oscillator, three I-F stages, second detector and noise limiter.

Provision is made for operation with either an external or built-in antenna. The antenna transformers incorporated in the receiver provide proper matching for either antenna system so that the built-in antenna assemblies may be completely disconnected from the input terminals when an outdoor antenna is available. Either a low impedance or a high impedance antenna source may be matched to the receiver input by means of the proper matching transformer.

All of the signal frequency and the associated oscillator circuits are tuned by means of ganged variable condensers. Total circuit capacities are so adjusted that the variable capacity provides a limited tuning range in the five highest frequency ranges with a resulting bandspread effect on the principal short-wave broadcast bands. All oscillator circuits are adjusted by means of air dielectric trimmer capacitors to minimize frequency drift possibilities.

Two stages of tuned radio frequency amplification are provided on all AM frequency ranges. Stage gains are so adjusted that optimum signal to noise ratios are provided without the generation of an excessive amount of spurious responses from strong local carriers.

A separate triode oscillator delivers its output to the first grid of the pentagrid mixer where it is mixed with the incoming signal voltage to provide an intermediate frequency of 455 kc. The local oscillator circuit is provided with frequency stabilizing elements to prevent excessive drift during warm-up and operating periods.

The three stages of intermediate frequency amplification provide for a wide range of selectivity control permitting adjustment for highly selective tuning on weak signals and wide band reception from strong local signals. By controlling the coupling of the tuned elements between the first and second and the second and third I-F stages three degrees of selectivity are provided. These are controlled from the front panel by means of a selector switch and are designated as "sharp," "medium" and "broad." To allow the listener to reduce the sensitivity for quieter interstation tuning and easier selection of the strong signals, two additional positions are provided on the same switch for "medium" and "broad" selectivity insensitive operation. The insensitive condition is established by introducing a negative voltage onto the grid circuits of the controlled tubes.

The I-F tuned circuits are distributed between the I-F tubes in the following manner: two between the mixer and the first I-F; four between the first and second I-F amplifiers; four between the second and third I-F amplifiers; and two between the third I-F and the detector, making a total of twelve tuned circuits. All coils are inductively tuned by means of molded iron cores and the components are so selected and arranged as to provide the maximum stability.

A double diode tube serves as a combination second detector and peak noise limiter. One diode rectifies the modulated signal as a conventional diode detector and the other diode shunts the detector load on strong impulse peaks, thereby providing a degree of noise limiting. The noise limiter is adjusted in such a manner that it limits only above 100% modulated levels and does not affect the quality of any amplitude modulated signals.

A milliammeter with the proper shunting is inserted in the cathode circuit of the first I-F amplifier, where it provides an indication proportional to the automatic volume control voltage and serves as a means for indicating to the listener the correct point of tuning when the tuning elements are adjusted so that the meter indicates a maximum reading (minimum current flowing).

## The FM Section

The FM tuner channel consists of two tuned R-F stages, a pentode mixer with a separate double triode oscillator, an AFC circuit, four I-F stages and a ratio detector.

Provision is made for a balanced dipole input, so that either an external dipole with a 300 ohm lead-in or a built-in folded dipole of the transmission line type may be utilized.

A ganged permeability tuner is provided for the two R-F stages, the mixer input circuit and the separate oscillator. In this tuner four molded iron cores, attached to a common mounting plate and driven through a stabilized lead screw arrangement, move concentrically with respect to four individual glass coil forms. The conductors for the four inductance coils are formed by spiral layers of deposited metal adhering to the glass forms.

The R-F stages utilize miniature pentodes having optimum performance in the FM range. Components and wiring are arranged to provide the highest gain attainable over this frequency range, without loss of stability.

The pentode mixer functions with control grid injection from the separate triode oscillator. The twin triodes of a 6J6 are connected in parallel to provide adequate oscillator voltage under the operating conditions of AFC loading. An intermediate frequency of 10.7 mc is produced.

The AFC system consists of a 6AU6 pentode operating as a reactance control tube across the oscillator tank circuit. The bias of this tube is supplied by the FM detector and is of such a polarity as to cause the tuning to shift toward the position of accurate centering for minimum FM distortion and noise.

Four double tuned transformers, inductively adjustable to 10.7 mc, are interposed between the I-F amplifier tubes to provide adequate adjacent channel selectivity. Coupling is adjusted to provide the proper pass band for the modulated FM signal.

The ratio detector system is of the latest design with proper construction for balanced operation and minimum response to amplitude modulation. Circuit constants are chosen to permit the handling of at least 75% of downward modulation.

The detector output circuit is followed by a double triode DC amplifier which supplies the DC zero center meter with the proper polarity for indicating correct FM tuning.

## The Noise Suppressor and Audio Input Section

The Noise Suppressor is the Olson type, in which the audio spectrum is divided into octaves and fed through rectifying elements having substantial cut-off below a threshold level. The lowest octave is passed through unaffected, but is set low enough to cut off an appreciable amount of the high frequency noise spectrum. When the audio level is very low, as it is with thermal noise, record surface noise, and other types of fluctuation noise, the upper octaves are practically cut off. However, as soon as the program level exceeds the threshold of cut-off the signal is passed through in all channels and the masking

effect of the music or speech with respect to the noise is relied on to a large extent to render the noise inaudible. It is the effect of reducing the noise appreciably during the quiet periods of reproduction that results in the outstanding performance of the system.

To furnish the suppressor system with sufficient input voltage a triode pre-amplifier is inserted ahead of the filter-rectifier arrangement. The triode sections of a 12AU7 are used to divide the audio signal into the upper controlled channels and the lower uncontrolled channel. To make up for the loss in gain in suppressor filter networks a triode amplifier follows the system before it feeds into the first stage of the main audio amplifier.

Following the pre-amplifier the audio signal enters one-half of a 12AU7 where it is delivered across a cathode load to the two upper filter channels, covering approximately 2500 to 5000 cps. and 5000 to 10,000 cps. The cathode load is particularly useful as a means for keeping the input impedance constant without the use of transformers or very elaborate matching networks. The other half of the 12AU7 feeds the low filter channel, covering the lowest audio frequency to approximately 2500 cps.

The two upper channels have as much filtering as practical for a home receiver ahead of the rectifying elements to keep the overall harmonic percentages below 2%. It is essential to utilize many of the possibilities for series and parallel resonance near the edges of the pass band to hold down the level of distortion in the cross region of the filter networks, because of the inherent distortion of the rectifying elements following the networks.

To regulate the threshold level of the rectifiers two 1N34 crystals are connected in series in each path to accumulate sufficient contact potential. The rectifiers are connected back to back to provide conduction on both halves of each cycle. Following these units in each channel there is a parallel circuit adjusted for geometric midband resonance.

The uncontrolled channel is a low pass LC arrangement. All of the outputs feed the control grid of the post amplifier.

To provide an adequate range of control for all types of phonograph records, it is necessary to provide more than a simple "on-off" switching for the noise suppressor. Due to the high level of certain "clicks" and "pops" and the high distortion level of many records, it is necessary to cut back from a pass band of 10,000 cps. In the switching arrangement for the suppressor advantage is taken of the fact that the filter channels are available to control their input and consequently the delivered output. In the first position of the suppressor control the system is bypassed and the audio signal is fed around the suppressor. This permits the audio system to reproduce very high fidelity programs, such as direct studio pickups of television, FM and very high quality professional recordings. In the second position the suppressor system is completely connected and the audio spectrum up to 10,000 cps. is passed without appreciable impairment. The noise is reduced in the two upper channels. In the third position the input to the upper channel is reduced with a considerably greater reduction in noise, but with some impairment of fidelity between 8000 and 10,000 cps. In the fourth position the upper channel is removed from the circuit and the fidelity is affected between 6000 and 8000 cps. In the fifth position the input to the middle channel is reduced, the noise is reduced and the fidelity is affected above 4000 cps. This arrangement allows the listener to play almost any type of record and it also provides an excellent arrangement for achieving a very high signal to noise ratio on weak signals.

The portion of the main audio amplifier included in the tuner chassis consists of a single stage (6C4 tube) for tone control purposes only.

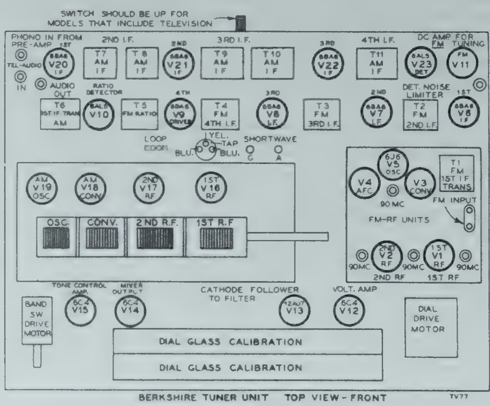
This triode feeds into a plate circuit network which is arranged in such a manner that both bass and treble control may be effected with variable resistors. Both controls are mounted on the front sub-panel where they couple to the tone scale elements to show the range which is being passed without attenuation in the audio amplifier.

## Audio and Power Supply Chassis

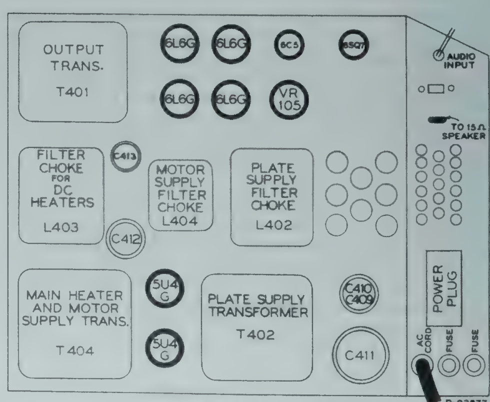
The audio and power supply chassis contains all of the main audio amplifier system with the exception of the first audio stage which is located in the tuner. All of the power supplies for the various elements of the receiver are also located here.

## The Audio Section

The basic audio system consists of four 6LG6 tubes in push-pull parallel with negative feedback from the output transformer to the cathode circuit of the second AF stage. The audio signal from the tuner chassis is fed into the control grid of a high gain triode where it is pre-amplified before reaching the grid of the audio phase inverter and driver. The phase inversion is accomplished by taking output from both the plate circuit and the cathode circuit of the 6J5. These signals feed the grids of the push-pull–parallel output pentodes. The 6L6 tubes are isolated to prevent spurious oscillations.




*Chassis (Top View)*




*Power Supply (Top View)*

# *Appendix A*

# U.S. Patents Granted

During the period from 1931 to 1943, eighteen U.S. patents dealing with circuits, mechanisms and cabinets were applied for and granted to inventors at Scott Radio Laboratories and a cabinet supplier. Patents are listed in the order of their filing date, rather than the grant date, because the filing date is a more accurate date of when the invention was made. The titles of the patent, the inventors names, and the filing dates and grant dates are listed below:

| | |
|---|---|
| 2,029,461 Remote Control for Radio Receivers (Brush) | 09/05/31.....02/04/36 |
| 1,986,525 Coil Changing Device (Pfaff, Coon & Roethel) | 10/20/32.....01/01/35 |
| 2,003,608 Tuning Control (Roethel) | 10/26/32.....06/04/35 |
| 2,068,110 Tuning Dial (Pfaff) | 12/30/32.....01/19/37 |
| 2,035,668 Radio Receiving System (Pfaff & Coon) | 01/09/33.....03/31/36 |
| 2,172,922 Automatic Noise Suppressor (Clay) | 04/04/36.....09/12/39 |
| 2,172,923 Antenna Coupler (Clay) | 06/15/37.....09/12/39 |
| 2,226,488 Radio Frequency Rejector Circuit (Clay) | 11/24/37.....12/24/40 |
| 2,231,863 Biresonant Circuit (Clay) | 11/24/37.....02/18/41 |
| 2,311,902 Anti-Backlash Dial (Roethel) | 11/06/40.....02/23/43 |
| 2,271,100 Sound Equalizer Reproduction System (E.H.Scott) | 12/24/40.....01/27/42 |
| 2,314,309 Radio Receiver (Hobbs) (see pages 116-121) | 02/02/42.....03/16/43 |

<u>Design Patents</u>

| | |
|---|---|
| 89,441 Radio Cabinet (Haggstrom) Imperial Grande | 12/24/32.....03/14/33 |
| 90,657 Radio Cabinet (Haggstrom) Westerley Grande | 07/09/33.....09/12/33 |
| 96,036 Radio Cabinet (Haggstrom) Laureate Grande | 05/09/35.....06/25/35 |
| 126,070 Loudspeaker Console (Haggstrom) | 01/02/41.....03/25/41 |
| 126,571 Amplifier Console (Haggstrom) Regent | 01/02/41.....03/25/41 |
| 131,042 Baffle Board for Radios and the Like (Haggstrom) | 03/03/41.....01/06/42 |

## Remote Control for Radio Receivers

On September 5, 1931, a patent was applied for an invention titled "Remote Control for Radio Receivers". In his patent application, the inventor, Chester E. Brush, stated the following:

*Remote controls or radio receivers have but recently attained the recognition of different manufacturers. However, nearly all of the so-called "remote controls" relate to a means for changing the tuning control within the receiver itself. This has been accomplished in many ways, among the more prominent are, the provision of a motor which may be actuated from a remote point to rotate or move the condensers increasing or decreasing capacities, or to move other tuning controls to a predetermined position whereby a certain station, which has been previously selected from a point within the radio broadcast band, is "tuned in".*

*Nearly all of the known controls are subject to certain inherent defects among which may be enumerated the addition of complicated mechanisms to accomplish the foregoing, and the fact that a slight shift in the allocation of a certain station in the broadcast wave band, necessitates a complicated readjustment beyond the comprehension of the average broadcast receiver audience.*

*Further difficulties are presented in proper control of volume. What would be sufficient volume for a local station may be totally insufficient for the distance station and vice versa.*

*It is therefore among the objects of this invention to provide a mechanism, which is simple to adjust and which will not readily lose its adjustment, whereby a predetermined broadcast station may be readily selected from a plurality of such stations from a point remote from the receiver.*

*Another object of this invention is to provide a control for instantaneously selecting stations at the receiver without the necessity of going through a number of stations to tune in the desired station.*

*Another object of the invention resides in the provision of a control which is particularly adaptable for superheterodynes and wherein the receiver may be controlled either at the receiver or remotely therefrom.*

*Another object resides in providing a control for a radio receiver wherein the receiver may be controlled only from a remote point.*

*Another object of the invention is to provide a remote control which not only selects the station desired, but wherein the volume may also be controlled at a point remote from the receiver and which is portable within the range of a connecting cable.*

*Another object of the invention resides In the provision of a remote control wherein the number of stations which may be selectively received, is limited only by the range of the receiver.*

*Another object relates to the provision of a control for a radio broadcast receiver wherein the operation of selecting a broadcast station is extremely simplified.*

A version of this invention was used in a remote control for the AC10 receiver. However, any remote control, which dragged a lot of RF around did not present a long term solution for remote control. All of the remote controls for receiver models that followed were motorized.

Feb. 4, 1936. C. E. BRUSH 2,029,461

REMOTE CONTROL FOR RADIO RECEIVERS

Filed Sept. 5, 1931

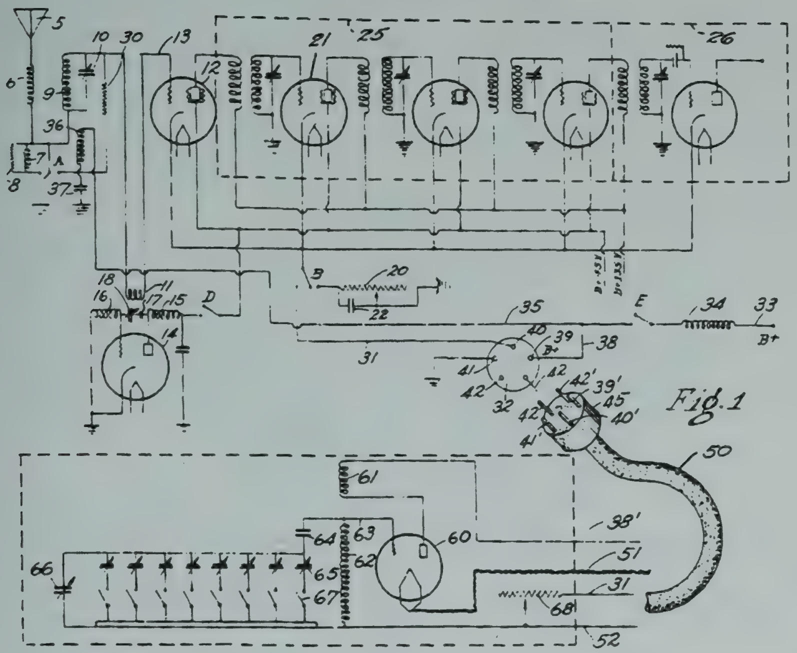


Fig. 1

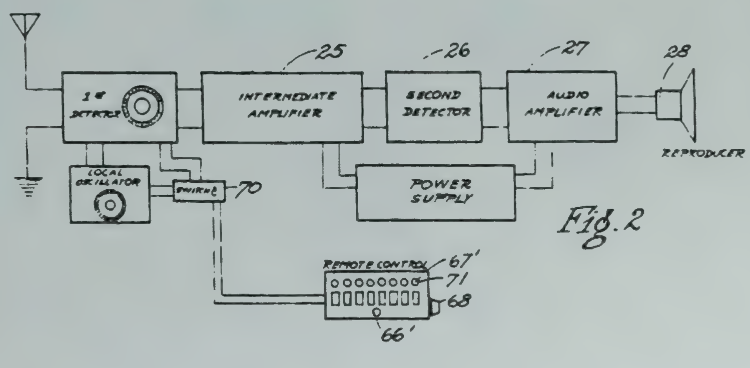



Fig. 2

Inventor

CHESTER E. BRUSH

By Richey & Watts

Attorneys

## Coil Changing Device

In the patent application, the inventors, Pfaff, Coon and Roethel state the following:

*In tuning radio receivers to various resonances in the short wave spectrum and broadcast spectrum it has been found desirable to use Inductances of different values to cover the various parts of the spectrum. The broadcast spectrum, extending from 550 to 1500 kilocycles may be readily covered by a single set of inductance coils; but to enable the receiver to be tuned to the spectrum for the short waves below 200 meters or above 1500 kilocycles it is advisable to selectively couple into the circuit coils of substantially smaller inductances as the shorter wave lengths are to be received. It has also been found that sensitivity and selectivity of the receiver and the facility with which the circuit may be tuned to resonance is better obtained by including several sets of inductances which may be selectively coupled into the circuit. In the past the changing of inductances has been accomplished by the use of "plug-in coils"; that is the desired inductances were wound upon a form or otherwise held in their desired conformation and were inserted in a socket for coupling the same into the circuit in much the same manner as a radio tube is placed In a socket. This was done manually, that is the desired coil was selected and inserted in the socket; and when the operator desired to receive signals on a different part of the spectrum. he removed that coil and Inserted another of the proper characteristics to permit the receiver to be tuned to the desired part of the spectrum.*

*This made it necessary for the receiver to be accessible for the insertion of the separate coils. Easy insertion of the coils is sometimes difficult because of the inability to align the contacts with the proper receiving apertures in the sockets. The manual operation also takes time.*

*It is therefore within the purview of this invention to provide a means for eliminating the manual changing of plug-in coils.*

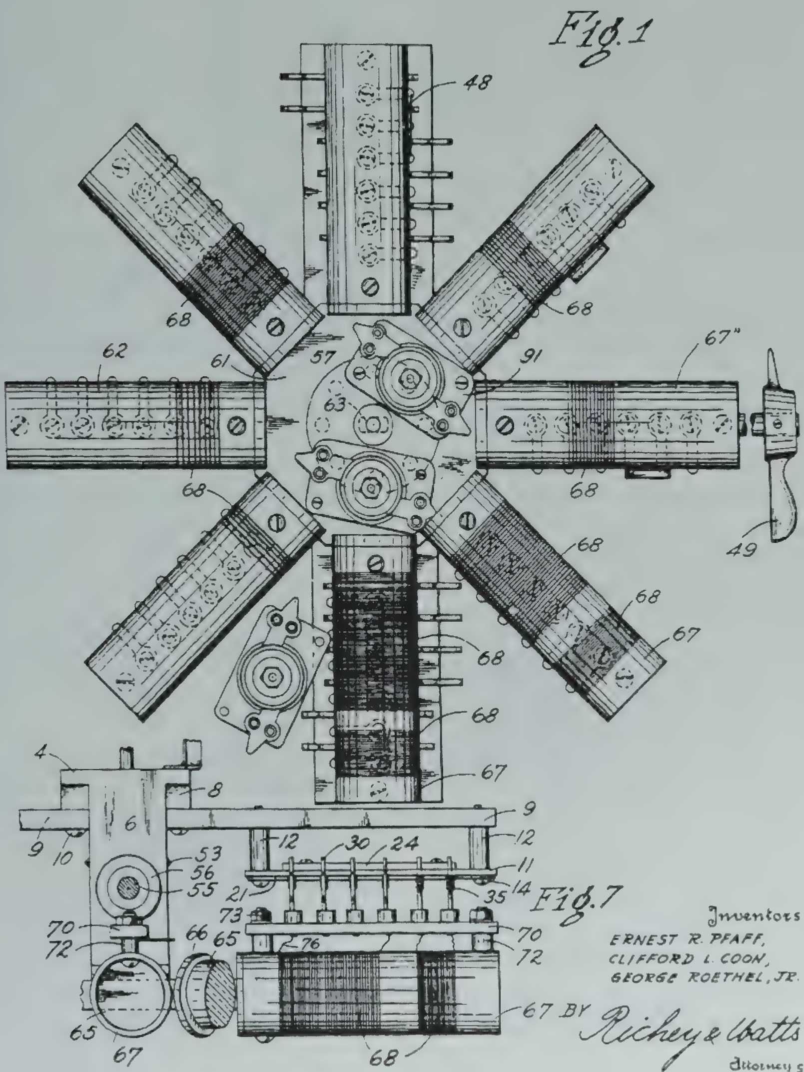
*Another object of the invention is to provide a compact coil arrangement which permits the coils to be shifted into and out of the circuit with ease and speed. Still other objects of the invention will become apparent from the following description of an embodiment thereof which together with the accompanying drawings forms a part of this specification.*

The ALLWAVE 12 was the last model with plug-in coils. The ALLWAVE DELUXE was the first receiver to incorporate the coil changing device of Patent #1,986,525. Following that the ALLWAVE FIFTEEN and other model variations of the Full Range High Fidelity ALLWAVE 23 incorporated this switching mechanism. Starting with the Quaranta, fixed coils with wafer switching were employed to change bands.

Jan. 1, 1935. E. R. PFAFF ET AL 1,986,525

COIL CHANGING DEVICE

Filed Oct. 26, 1932



## Tuning Control and Tuning Indicator

On October 26, 1932, George Roethel, Jr. (mechanical engineer) filed for a patent for a Tuning Control.

On December 30, 1932, Ernest Pfaff filed for a patent called a tuning dial. Actually, it was combination of tuning control and a tuning indicator.

In their applications they stated the following:

*Roethel stated:*

*This invention relates to an improved device for actuating the tuning control of a radio receiver and more particularly for an improved tuning condenser control.*

*The objects of the invention are to provide a tuning control which is positive in action and has no lost motion between the various elements.*

*Another object of the invention resides in a drum type condenser control in which cords or cables as a driving means have been eliminated.*

*Another object of the invention resides in the provision of the drum type condenser control which is compact, utilizing but a small space for the components thereof.*

*Another object of the invention is to provide a condenser control that is smooth in operation, economical, and durable in construction.*

*Pfaff stated:*

*This Invention relates to improvements in radio receiving apparatus, and more particularly to an improved indicator for indicating the wavelength to which the receiver is tuned and for indicating that the receiver is tuned to maximum resonance with an incoming signal.*

*In radio receivers it has been common practice to provide a calibrated dial connected to a tuning instrument such as a condenser or a series of condensers or the like to indicate the wavelength to which the receiver is tuned. The dial is usually calibrated in kilocycles or meters but in some instances may be as arbitrary calibration. It Is also common practice in tuning receivers to provide a separate instrument to indicate when the receiver is tuned to resonance. This instrument usually comprises an electric measuring instrument which is coupled into the radio receiver circuit in such a manner that an indicator on the instrument, usually a swinging arm or hand, is swung by the current produced in the receiver by the incoming signal. When so connected the point where the instrument shows the greatest hard swing indicates the maximum current and is the point at which the set is tuned most perfectly to the incoming signal. This eliminates guesswork based on the car of the operator as to when the receiver is properly tuned to a signal. These two functions namely knowing what wavelength the receiver is tuned to and when it is properly tuned in to a signal, in a radio receiver have always been accomplished by two separate and distinct indicators and it is necessary for the operator to observe separate instruments disposed on the radio receiver panel.*

*It is desirable in modern radios, which are to be used in the home, to provide a radio which blends with the rest of the furnishings and to eliminate therefrom all unnecessary and mechanical appearance. It is also desirable in producing a radio receiver to provide a receiver which is easy to tune and requires a minimum number of dials and apparatus to be operated in order to properly receive an incoming signal. A profusion of indicators and dia!s is always confusing to the average listener, particularly those who have little or no idea of what is going on in a radio receiver. It is also desirable to provide simplicity in appearance of the receiver.*

*It is therefore the purpose of this invention to provide an improved tuning indicating apparatus in which the design of a radio panel, tuning and apparatus thereon lends itself to simplicity, compactness, and where facility in tuning is accomplished. By the invention as disclosed herein it has been possible to simplify the structures of the prior art and to consolidate the parts into a compact indicating device which still retains all the functions of the prior art without the disadvantages thereof.*

*This invention in accomplishing the foregoing and eliminating the defects of the prior art, comprises generally in combining the indicator for designating the wavelength and the indicator for designating the resonance into a single instrument.*

*It is therefore the purpose of this invention to provide an improved tuning indicating apparatus in which the design of a radio panel, tuning and apparatus thereon lends itself to simplicity, compactness, and where facility in tuning is accomplished.*

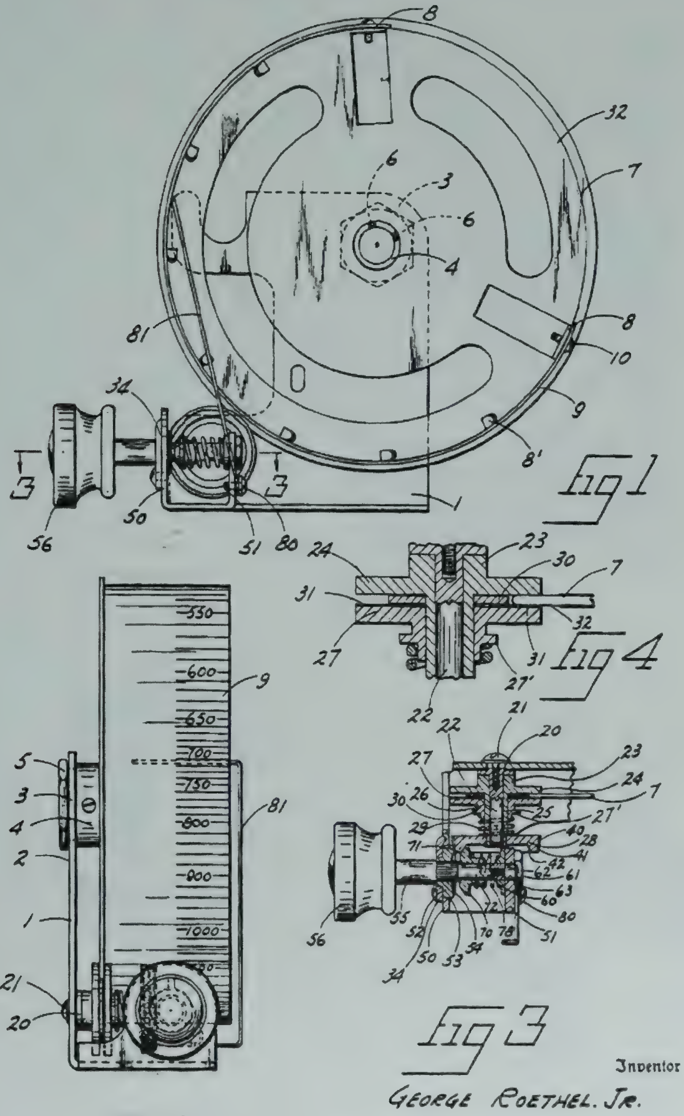
June 4, 1935.

G. ROETHEL, JR

2,003,608

TUNING CONTROL

Filed Oct. 26, 1932




Inventor

GEORGE ROETHEL. JR.

By Richey & Watts

Attorney

Jan. 19, 1937. E. R. PFAFF 2,068,110

TUNING DIAL

Filed Dec. 30, 1932

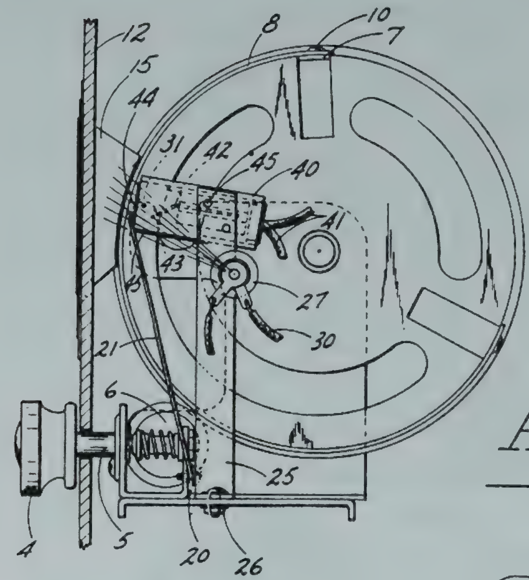



Fig 1

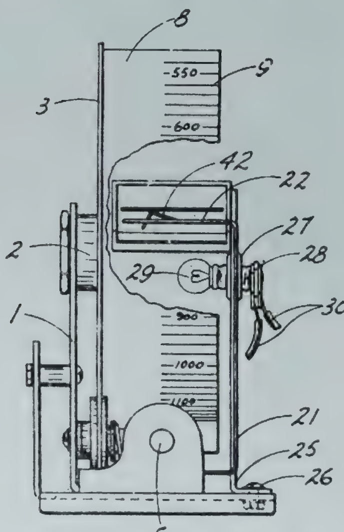



Fig 2

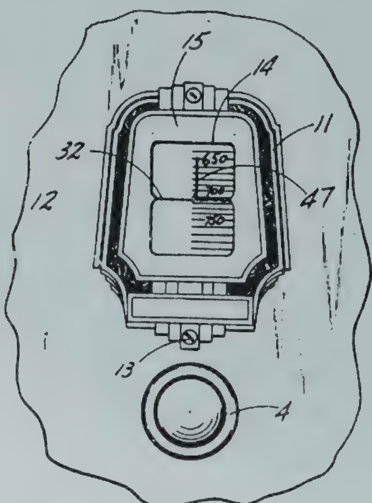



Fig 3

Inventor

ERNEST R. PFAFF

By

Richey & Watts

Attorney

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## Radio Receiving System

The scope of the coil changing device patent was extended into a complete receiver system incorporating it, by filing a patent application on January 9, 1933. In that application the following was stated:

*This invention relates to improvements in radio receivers and more particularly to a receiver of the superheterodyne type adapted to receive radio signals with fidelity, selectivity and sensitivity over a broad range of frequencies such as the broadcast and short wave spectrums.*

*Heretofore efforts have been made to construct radio receiving sets which would receive signals of low frequency as well as those of high frequency. Receiving sets have been proposed in which one complete circuit was employed for low frequency signals and another independent circuit was employed for high frequency signals. Each circuit was independent of the other or others and was tuned independently of the other circuits. This involved separate tuning apparatus for each circuit and made the set unnecessarily cumbersome.*

*Other attempts have been made in which it was proposed to use a single tuned circuit (the oscillator circuit) for tuning the receiver to resonance to the particular frequency which it was desired to receive. Since a single tuned circuit, as such, is very inefficient and incapable of reception of weak or distant signals on all of the various wave bands the effort was not entirely successful.*

*Other efforts have included the use of two tuned circuits, namely the radio frequency circuit and the oscillator circuit, and separate dials for each circuit. This tended to complicate tuning because, if the condensers were rotated together the same amount, they would not track for all frequencies. The use of separate tuning dials for each circuit was a further disadvantage present in such systems.*

*Other attempts included the provision of a plurality of individual manually changed plug-in coils.*

*But such a receiver requires that it and the coils be accessible for such manual plugging-in. The shifting from one wave band to another in this receiver involved time and caused annoyance because the coils were not always easily aligned with the contacts. A succeeding effort was made to avoid the foregoing disadvantages whereby the coils were stationarily mounted and leads from the coils were carried to a multipolar switch so arranged that the individual coils could be selected by a switch unit.*

*This, however, had a disadvantage wherein although time and annoyance were cured the new arrangement caused a considerable loss in efficiency because of the long leads necessary to connect the coils to the switch and due to the fact that the coils took up considerable space and could not be arranged compactly and placed in the best place for efficient reception.*

*We have found that it is possible to maintain substantially the same selectivity, sensitivity, and efficiency of reception throughout substantially the entire radio spectrum without encountering any of the previous disadvantages such as cumbersomeness, more compact construction, manually manipulated coils, separate tuning devices, variable sensitivity, selectivity, and efficiency, and have accomplished these results by a new combination of elements and a new mode of operation. The means and method by which these new and improved results are obtained may be readily visualized and understood by a brief description of our invention.*

*Generally speaking, we accomplish the foregoing results as follows: we provide a superheterodyne circuit for long waves and provide means for selectively adapting the receiver for the various short wave bands. We provide simultaneously actuated tuning condensers for the oscillator and detector circuits of the superheterodyne which we cause to track with each other for all frequencies. We provide a plurality of inductances which are respectively adapted to receive signals on different frequency bands and mount them and ideally and compactly locate them so that by a single simple mechanical means they may automatically be selectively included in the oscillator and detector circuits to obtain the best electrical characteristics therefrom.*

*The means used to couple selectively the inductances into the circuits may also simultaneously change the tuned antennae circuit, in case it was tuned, to an untuned antennae circuit, change the capacitances which tune the inductances and change the nature of the coupling between the circuits.*

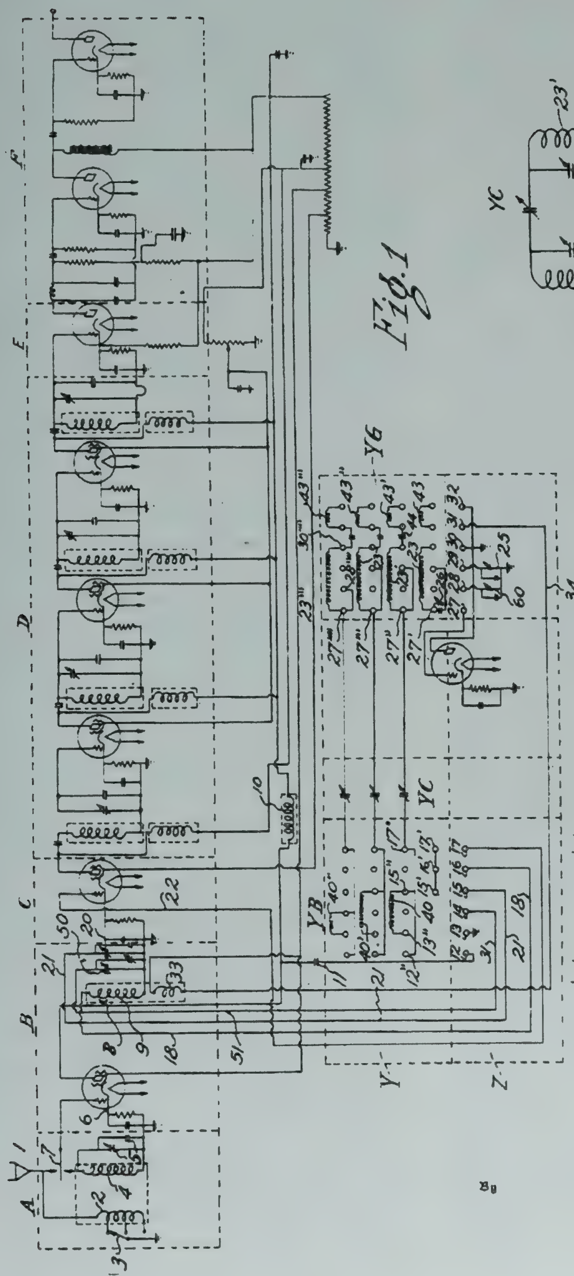
*By means of the foregoing parts and combinations of parts we have provided a receiver for receiving radio signals throughout the entire radio spectrum having oscillator and detector condensers controllable simultaneously by a single means to tune the receiver to a signal efficiently, with fidelity and selectivity and sensitivity, and having common control means for selectively coupling different inductances into the oscillator and detector circuits, change the method of and apparatus for coupling the circuits, substitute the different capacities for tuning the inductances, and, if desired, change the antennae circuit.*

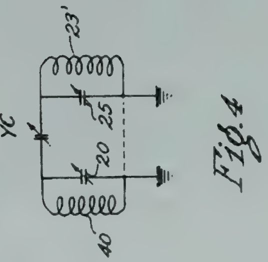
This circuit was incorporated in the ALLWAVE 12 DELUXE.

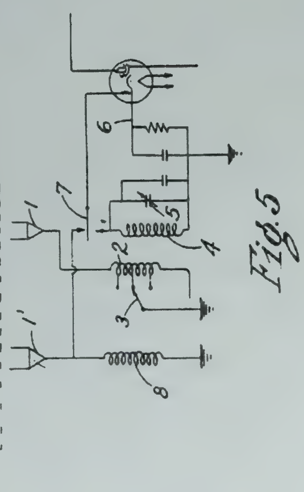
March 31, 1936.　　　E. R. PFAFF ET AL　　　2,035,668

RADIO RECEIVING SYSTEM

Filed Jan. 9, 1933




Inventors
ERNEST R. PFAFF
& CLIFFORD L. COON

By Richey & Watts
Attorneys

## Automatic Noise Suppressor

In his patent application, filed on April 4,1936, Murray Clay stated the following:

*Interference in radio receivers commonly referred to as "static" is one of the greatest sources of annoyance to those who listen to reception. Of the sources of "noise" perhaps the most common are those which result from the operation of various electrical devices. In high frequency reception the greatest offender is the automobile, each spark plug of which is a miniature transmitting station. Many other things cause undesirable interference such as light switches, violet ray machines, and innumerable electric appliances. Static, of course, such as is ordinarily caused by lightning is also periodically present.*

*Heretofore various attempts have been made to eliminate outside electric interference and although some of the arrangements have resulted in material improvements in noise free reception, there have been numerous drawbacks to the previous circuits. The most common means of electric interference elimination has been to cut off the high frequencies. This at the present time is undesirable since the trend is toward high fidelity reception. Other means for accomplishing the desired end have required complicated and expensive apparatus and at its best was none too effective. It has become recognized that the electric disturbances are annoying because their amplitude so greatly exceeds the amplitude of the signal being received. Electric disturbances that do not exceed the amplitude of the signal being received, while undesirable and detracting to some extent from the fidelity and rendering the reception less intelligible, are practically lost in the signal being received and ofttimes are unnoticeable.*

*It has been proposed to amplify the noise peaks and use the amplified signal after rectification to control the gain of the receiver, This although a decided improvement over prior methods, still has its disadvantage in that a continuous manual adjustment is necessary to obtain optimum performance on signals of various strengths, fading signals, and in tuning from a signal of one level (strength) to another. This made it necessary for the operator to be continuously on the alert to change the manual adjustment, which continual adjustment is particularly undesirable for high frequency reception where considerable variations in signal strength occur (fading) over a short space of time. If the signal became too strong, the suppression circuit would operate to cut off the signal, and if it became too weak, the margin between the desired received signal and the cut-off point became so great that the interference comes through undiminished.*

*By the present invention I am able to provide noise suppression which is entirely automatic and where the silencer circuit does not operate on strong desirable signals to distort or block them and which is effective to permit the silencer circuit to operate effectively during the reception of very weak signals. The silencer circuit at all times is so related to the strength of the desired signal that it operates effectively to silence large noise impulses even though the desired signal may vary widely in amplitude due to fading.*

*The noise impulse silencing is accomplished by amplifying the noise impulse and using the noise energy to block one of the I. F. amplifier tubes in such a manner that the receiver is effectively silenced for the duration of the noise impulse. This silencing is effective and is better understood by a consideration of the characteristics of the noise impulse which caused the disturbance. The noise impulses themselves are generally of extremely short duration, in the nature of one one-thousandths of a second. They are, however, transformed into impulses of longer duration by the various increments of the receiver itself, such as the loud speaker, telephones, etc. Therefore the problem is to silence the noise before it reaches the elements which increase the duration of the noise. This is accomplished, as stated, by using the noise impulse to control a biasing means for a cut-off tube which silences the receiver for the duration of the impulse, and which after the impulse is passed allows the receiver to resume its normal operation. The momentary cut-off during the reception of the signal is unnoticeable, even when the cut-off is caused by interference generated in the ignition systems of automobile engines, because the actual duration of the interference impulse is so short, and the cut-off period is so short that the persistence of hearing does not recognize the cut-off, the action being analogous to the action of the eye in viewing motion pictures where the pictures apparently do not flicker because the eye is unable to detect the interruption between film picture sequences.*

*The noise impulse circuit is made to follow the signal automatically by applying a delayed voltage to the noise impulse circuit consisting of a rectified bias which is essentially equal to one-half of the modulation envelope*

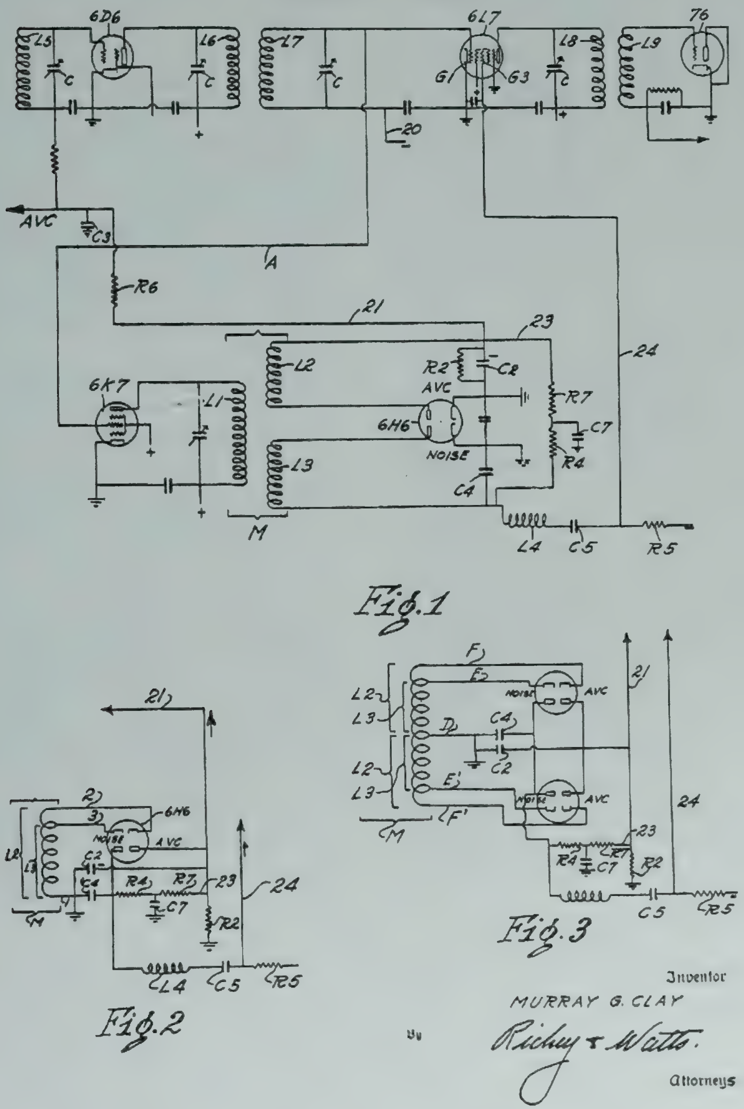
amplitude in addition to a fixed additional bias, the two biases at all times exceeding the maximum, positive or negative peak amplitude of desired signal so that the noise impulse will be applied to the cut-off element of the circuit only when the noise Impulse exceeds the amplitude of the desired signal. The additional bias may be removed from the circuit in the instances where it Is found desirable when the signal strengths encountered are particularly weak.

This circuitry was used in the Quaranta and the Philharmonic.

**Sept. 12, 1939.** M. G. CLAY **2,172,922**

AUTOMATIC NOISE SUPPRESSOR

Filed April 4, 1936



## Antenna Coupler

In the application filed on June 15, 1937, Murray Clay stated the following:

*In antenna couplers, the object is to obtain the greatest transfer of signal energy caused by interception of desirable signals from the antenna to the receiver, with a minimum transfer of undesirable disturbances caused by various electrical apparatus. These forms of energy are picked up by both the antenna proper and also the lead-in from the antenna.*

*It has been found, however, that the lead-in wires from the antenna are often more prone to pick up the undesirable electrical impulses because they actually come closer to the originating points of such impulses. Many attempts have been made to eliminate the disturbances picked up by the lead-in, one such being the use of two lead-in wires in either a transposed relation or as a twisted pair, the object being to have both wires so exposed to the undesirable electrical Impulses that each has an equivalent pick-up with the impulses in each wire in phase with those of the other. The signals in one wire are then supposed to oppose or cancel those in the other wire. In antennas and their lead-ins of the type under consideration, two sets of currents arise due to the interception of electrostatic and magnetic waves. Signals which arise in the horizontal or flat top portions of antennas provide currents which are known as "out of phase" or transverse currents, while those picked up in the double lead-ins of the twisted pair type and which may be considered as traveling downward or upward in each wire simultaneously, are known as "in phase" or longitudinal currents.*

*Inasmuch as the currents produced by lead-in pick-up are undesirable, it is proposed to dispose of these currents and to use with the utmost efficiency the currents generated in the flat top portion of the antenna.*

*Although certain systems have heretofore been designed which have to some extent attempted to accomplish the foregoing, and with some measure of success, there have been certain undesirable features In the previous antenna circuit arrangements. Not least of these are the current losses before the signal Is amplified. The antenna coupler itself, having in most instances been a separate unit, an appreciable loss of signal strength has been apparent, particularly since it has previously been difficult to secure a high degree of efficiency in that unit. Heretofore built-in couplers that gave an increase in efficiency in signal transfer have resulted in a sacrifice of the noise reducing ability.*

*Still other disadvantages present in separate couplers Included the necessity of added controls not conveniently operable with the regular set controls.*

*By my present invention I have provided an antenna coupler which has avoided the shortcomings of the prior devices. To this end, the separate coupler has been eliminated and the efficiency as a result has been materially improved, making the circuit capable of receiving weaker stations, and the ratio of the desired signal, to noise picked up by the lead-in, is increased over the best previous systems by a very large factor.*

*The foregoing is accomplished as will hereinafter more clearly appear by providing a complete elimination of capacitive coupling between the antenna system and the first tuned circuit; by obtaining a substantially exact magnetic balance hence avoiding undesirable transfer of magnetic energy due to longitudinal currents; by providing an exact impedance match of the primary coil to antenna lead-in for developing maximum transfer of the magnetic field due to transverse currents; by providing maximum energy transfer from antenna to grid of first tube on each wave band; and by complete elimination of intermediate transformers at the receiver end of the transmission line and their unavoidable loss of efficiency and narrow band coverage.*

Starting with the Philharmonic, this coupler was used in all later Scott AM and FM receivers through to the model XII and the Communications receiver.

Sept. 12, 1939. M. G. CLAY 2,172,923

ANTENNA COUPLER

Filed June 15, 1937 2 Sheets-Sheet 1

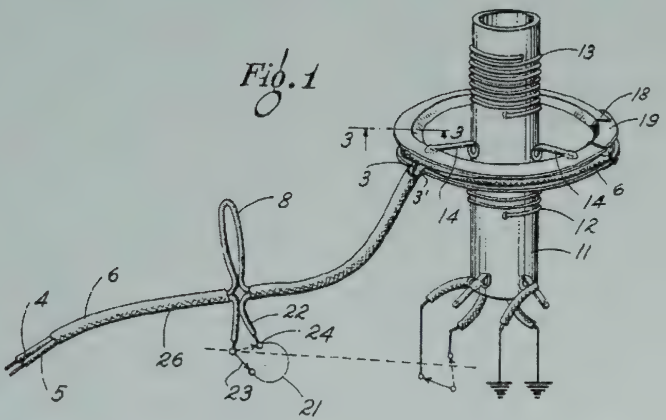



Fig. 1

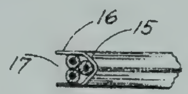



Fig. 3

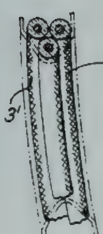



Fig. 6

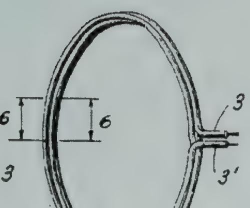



Fig. 4

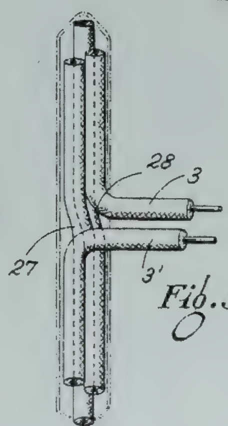



Fig. 5

INVENTOR.
MURRAY G. CLAY

BY Richey & Watts
ATTORNEYS.

ANTENNA COUPLER

Filed June 15, 1937 2 Sheets-Sheet 2

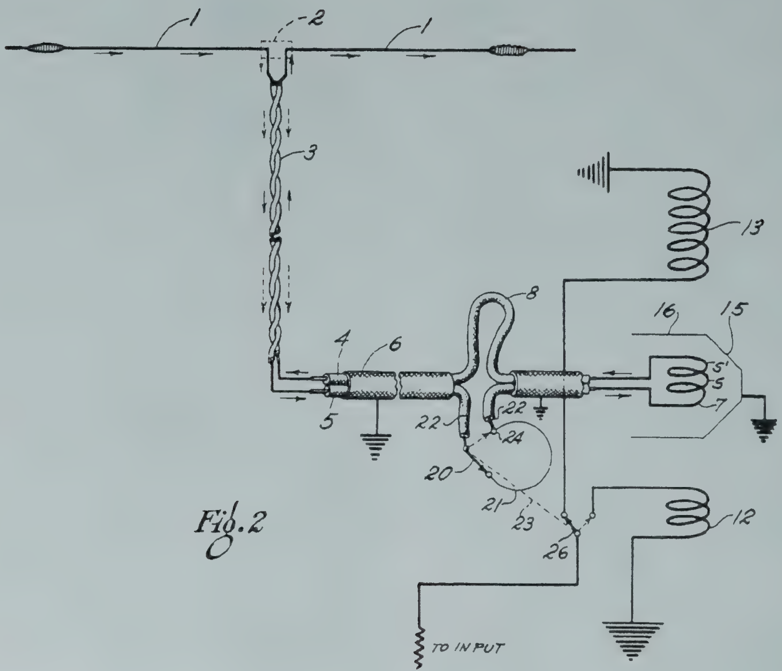



Fig. 2

INVENTOR.
MURRAY G. CLAY

BY Richey & Watts.
ATTORNEYS

## Radio Frequency Rejector Circuit

On November 24, 1937, Murray Clay filed a patent application for this invention. In the application he stated the following:

*Heretofore simple circuits have been available for the purpose of coupling two or more oscillatory systems, but these circuits have not provided appreciable discrimination against certain unwanted signals which have sometimes been within, but have generally been outside of the normal operating frequency range of the system. As a result of this, particularly in the case of the superheterodyne type receiver which embodies a fixed frequency amplifier of high gain following one or more tuned radio frequency selector circuits, strong undesired signals, generally close to the frequency of the fixed frequency amplifier in the case of the superheterodyne, get through to the detector after which they are amplified and reproduced from the loudspeaker.*

*Accordingly, it may be stated that the principal object of this Invention is to provide a circuit arrangement whereby, in combination with certain practical coupling and tuning systems, interfering signals may be subjected to any desired degree of attenuation at any required frequency.*

*The novel features which I believe to be characteristic of my Invention are set forth in particularity in the appended claims. The Invention itself, however, both as to its organization and method of operation, will best be understood by reference to the following description, taken In connection with the drawings, in which I have indicated diagrammatically several circuit organizations whereby my invention may be carried Into effect.*

*Fig 1 shows a conventional tuned radio frequency circuit coupled to an antenna system. This circuit is familiar to those acquainted with the prior art and is shown for the purpose of analyzing the present invention.*

*Fig. 1a illustrates schematically the fundamental circuit of Fig. 1;*

*Fig. 2 Is similar to Fig. 1 except for the addition of one circuit element for the embodiment of the present invention is one of its aspects;*

*Fig. 3 is similar to Fig. 2 and represents an embodiment of the present invention in another of its aspects;*

*Fig. 4 shows a pair of tuned radio frequency circuits, which may or may not be band passed, embodying the present invention in still another of its aspects;*

*Fig. 5 is a graph which indicates qualitatively in "Curve A" the selectivity characteristic of the system of the prior art shown in Fig. 1, while "Curve B" indicates one of the many possible selectivity characteristics obtainable from the use of the present invention.*

*Referring now to the accompanying drawings, wherein similar circuit elements are denoted by corresponding reference numerals and letters, it is first pointed out that the general purpose of the circuit arrangements to be hereinafter disclosed is to make it possible to reduce, or substantially eliminate, strong interfering signals (which may be, but generally are not, within the normal tuning range of the system) with the utmost simplicity and economy. In order to point out the features of the present invention whereby these objects are accomplished, there is shown in Fig. 1 a conventional tuned radio frequency circuit, of the prior art, coupled to an antenna system.*

*The inductance L is tuned mainly by the tuning condenser and trimmer C. However, a small portion of the total tuned impedance appears across the series condenser C1 which ordinarily has a capacity value at least ten times that of the tuning condenser, and is shunted with the reactance appearing at points P and Q due to the antenna system. Thus the antenna and the tuned circuit are coupled by the common Impedance through P, Q which, at the resonant frequency of the tuned circuit, is nearly a pure resistance approximately equal to, but slightly less than,*

$$Z_L(C/(C_1+C))$$

*in which Z is the resonant impedance appearing across L. However, at frequencies considerably below the frequency to which the resonant circuit; L, C, and C1 is tuned, the antenna system "looks into" a capacitive reactance at P, Q, which is mainly due to C1, and which Increases with decreasing frequency. Thus, as the input frequency is lowered, this antenna coupling system degenerates into the circuit of Fig. 1a which will be recognized as constituting a lowpass filter. C2 is a blocking condenser of high capacity which serves to prevent loss of automatic gain control (AGC) voltages in case the antenna becomes grounded. "Curve A" of Fig. 5, indicates qualitatively the response versus frequency characteristics which may be obtained with the circuit tuned to the middle of the American broadcast band. It*

*should be noted that while the response falls off rapidly at points above resonance, below resonance the response falls off less rapidly approaching a constant value considerably above that obtained at the same frequency increment above resonance.*

*The circuit of Fig. 2 Is different from that of Fig. 1, in that a small inductance L1 is added for the purpose of realizing the advantage of a principle of the present invention. In this case the value of inductance L1 is chosen to resonate with the capacity C1 to some frequency which it is desired to attenuate. At this frequency the common impedance coupling the antenna system to the tuned circuit is a resistance the value of which is very much less than the reactance of the condenser C1, thus greatly reducing the coupling between the antenna and the grid circuits, resulting in an attenuation of the undesired frequency.*

*"Curve B" of Fig. 5 indicates qualitatively the response versus frequency characteristics which may be obtained, with this embodiment of the present invention, with the system tuned to the middle of the American broadcast band. Note that, while this curve is similar to the first mentioned curve over a considerable portion of its range, at some selected frequency the response dips to a considerably lower value. As an example of a useful application of this invention in one of its practical aspects the following description is given:*

*A superheterodyne receiver having an "Intermediate frequency" of 465 kilocycles was designed to cover a frequency range from 550 to 1500 kilocycles on one of its tuning bands. This receiver employed two tuned radio frequency circuits, the first of which was similar to that shown in Fig. 2 in which a value of 5,000 mmf. was chosen for capacitor C1 as providing suitable antenna circuit "gain" in conjunction with the highly efficient secondary inductor used for L. L1 was then chosen to have a value of approximately 24 microhenries to resonate with C1 to 465 kilocycles in order to considerably attenuate code signals and other forms of interference which would otherwise reach the converter stage with sufficient intensity to be amplified by the intermediate frequency amplifier which operated at 465 kilocycles.*

*In Fig. 3 is shown a modification of Fig. 2 representing a practical embodiment of the present Invention in another of Its aspects. In this case inductors L, and L1 are coupled to each other in order to produce the mutual inductance M. By suitable choice of the polarity of M and the magnitudes of M and L1, a voltage may be induced in L which is equal and opposite to that appearing across points P and Q at some selected frequency. A very great effective attenuation is readily attainable in this case since L1 and C1 act, as previously described, to greatly reduce the coupling between the antenna and the tuned circuit at the selected frequency, while, in addition, the small mutual induction M opposes the minute voltage which would otherwise remain.*

*In Fig. 4 are shown two tuned radio frequency circuits used to couple the output element of an electron discharge device V to the input element of a second electron discharge device V1. In this case tuned circuit L3, C3 is coupled to tuned circuit L4, C4 through the common Impedance C5, L5 between the points P and Q. Here the two elements of the common coupling impedance are chosen to afford three desirable characteristics to the system as follows:*

*A. The product of C5, L5 is chosen to provide a minimum of coupling at some undesired frequency.*

*B. The value of C5 is chosen to provide the desired coupling at the low frequency end of the tuning range of the system, bearing in mind the fact that this also determines the value of L5.*

*C. The value of L5 is chosen to provide, the desired coupling at the high frequency end of the tuning range of the system, bearing in mind the fact that this also determines the value of C5.*

*A suitable compromise may have to be decided upon for steps B and C after step A has been determined. However, this coupling system is capable of endowing the overall characteristics of the two tuned circuits with any desired balance between the low and high frequency signal efficiencies and, furthermore, is capable of providing a considerable degree of attenuation at some selected frequency.*

*Again, in the case of Fig. 4, a small amount of mutual induction may be introduced between L4 and L5, as indicated by the dotted bracket M; a further aspect of the present invention. In this manner, as described in connection with Fig. 3, practically complete attenuation of signals at some selected frequency can be obtained.*

Dec. 24, 1940. M. G. CLAY 2,226,488

RADIO FREQUENCY REJECTOR CIRCUIT

Filed Nov. 24, 1937 2 Sheets-Sheet 1

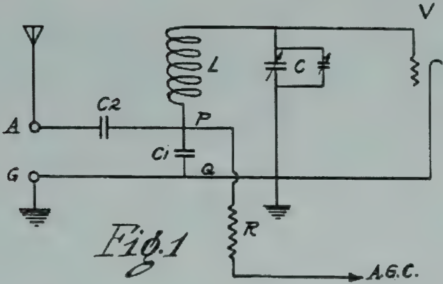



Fig.1

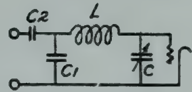



Fig.1a

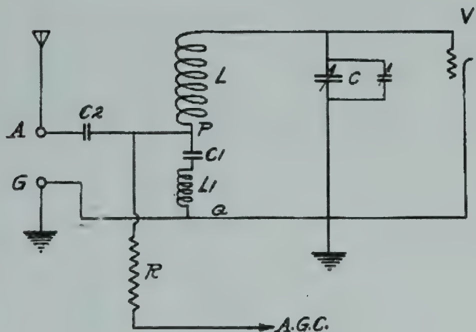



Fig.2

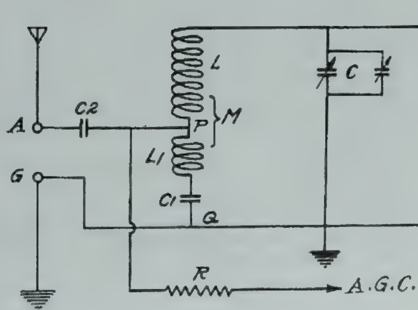



Fig.3

INVENTOR
MURRAY G. CLAY

BY Richey & Watts
ATTORNEYS

RADIO FREQUENCY REJECTOR CIRCUIT

Filed Nov. 24, 1937 2 Sheets-Sheet 2

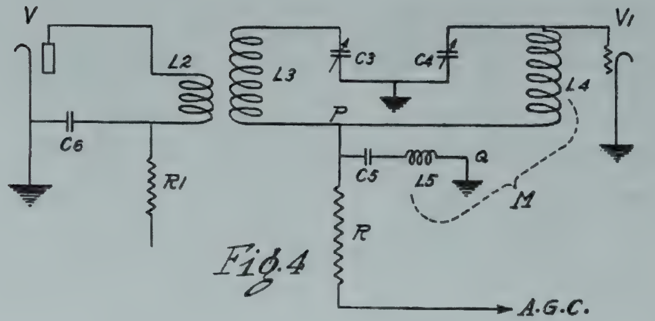



Fig.4

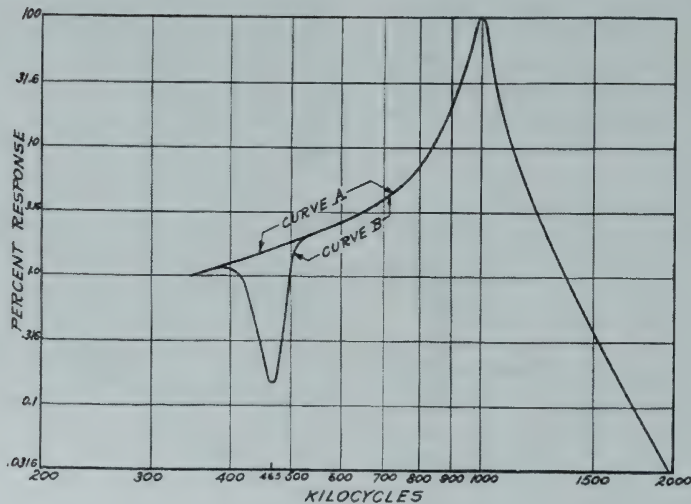



Fig.5

INVENTOR
MURRAY G. CLAY

BY Richey & Watts
ATTORNEYS

## Biresonant Circuit

In the patent application filed on November 24, 1937, the following was stated by Murray Clay:

*My present invention relates to tuned alternating current coupling systems and more particularly to such systems which are capable of providing, in conjunction with electron discharge devices and suitable signal sources, response versus frequency characteristics in which the response over a considerable frequency range may be essentially constant while the response over a second considerable portion of the frequency range may be considerably augmented and may further be provided with a third frequency range, within the second, in which the input signals are considerably attenuated at some selected frequency.*

*Heretofore coupling circuits providing essentially constant response versus frequency characteristics over a considerable range of frequencies and a considerably augmented response over a second range of frequencies have been available. However, practical experience has shown that these circuits of the prior art are, in many cases, inadequate to meet the exacting needs of the communication art. For example, it would be highly desirable, in the audio frequency amplifying system of a radio broadcast receiver, to considerably augment the reproduction of the lower audio frequencies corresponding to the bass notes In musical reproduction, without, at the same time, intensifying the lower voice frequencies which results in "boomy," unnatural reproduction of speech. However, systems of the prior art which augment a range of lower audio frequencies acceptably wide for musical reproduction intensify the lower voice frequencies excessively, while systems of the prior art which do not excessively intensify the lower voice frequencies fail to augment a sufficiently wide band of frequencies to include all of the important lower audio frequencies corresponding to the bass notes in musical reproduction.*

*Accordingly it may be stated that it is one of the principal objects of this Invention to provide a configuration of circuit elements which, in conjunction with suitable electron discharge devices, or a suitable signal source, is capable of affording a response versus frequency characteristic which is essentially constant over a considerable range of frequencies and is considerably augmented over a second band of frequencies which is sufffciently wide to include all of the important lower audio frequencies corresponding to the bass notes in musical reproduction, but which does not appreciably intensify the lower voice frequencies.*

*Another frequently encountered important respect in which systems of the prior art have been inadequate to meet the needs of the communication art in a simple practical manner is cited herewith: Due to the inevitable presence of a sometimes small, but more frequently considerable amount of low frequency voltage, corresponding mainly to the first or second harmonic of the alternating current power supply frequency introduced into the signal circuits of either the broadcasting stations or the receiver, or both, it would be highly desirable to avoid intensifying alternating voltages appearing at exactly these two frequencies without sacrificing an appreciable portion of the musical bass frequency range within which the first and second harmonics of the power supply frequencies generally appear.*

*Accordingly it may be stated that it is another principal object of this invention to provide, in conjunction with suitable electron discharge devices or a suitable signal source, a considerably augmented frequency response over the major portion of the frequency range corresponding to the important bass note frequencies of musical reproduction, and at the same time, considerable relative attenuation of the first and second harmonics of the power supply frequency.*

*It is a fact well known to those skilled in the art that It is possible to obtain a considerably improved ratio of inductive reactance to effective resistance in an "iron core" type inductor if the magnetizing flux, due to the direct current component in the anode circuit of the electron discharge device or devices to which it is connected, is either minimized or eliminated.*

*Hence another important object of the present invention Is to provide a coupling system in which the resultant magnetic flux, remaining in the iron cored inductors used in the system, due to the direct anode current component of the electron discharge devices associated with the inductors, may be substantially eliminated.*

Feb. 18, 1941. M. G. CLAY 2,231,863

BIRESONANT CIRCUIT

Filed Nov. 24, 1937

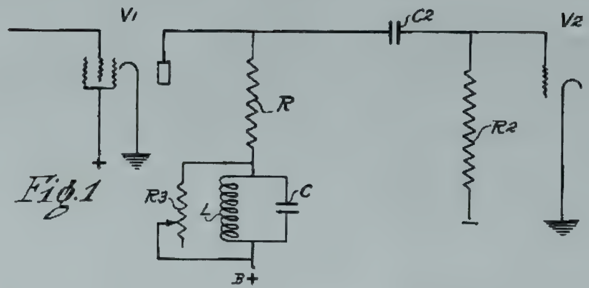



Fig.1

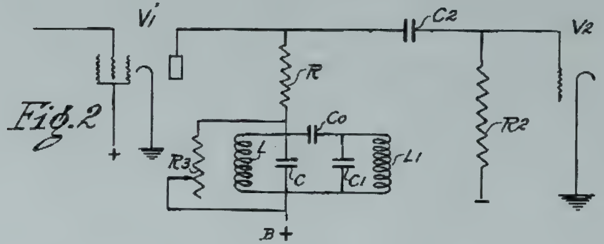



Fig.2

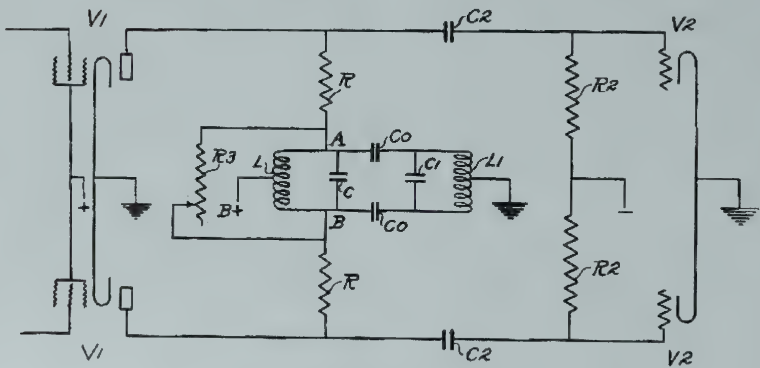



Fig.3

INVENTOR
MURRAY G. CLAY

BY Richey & Watts

ATTORNEYS

Feb. 18, 1941. M. G. CLAY 2,231,863

BIRESONANT CIRCUIT

Filed Nov. 24, 1937

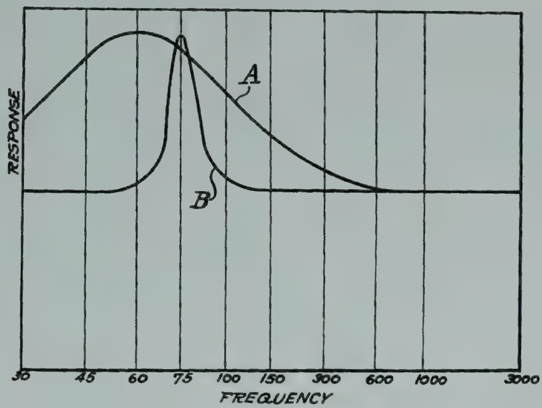



Fig. 4

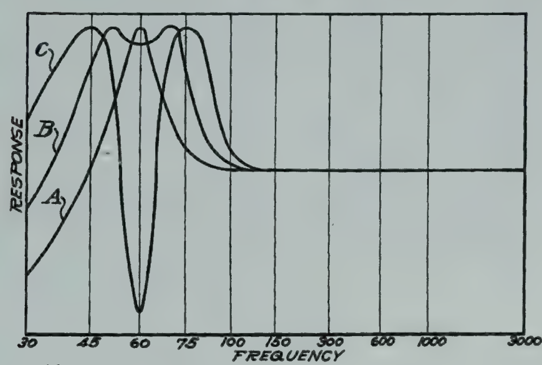



Fig. 5

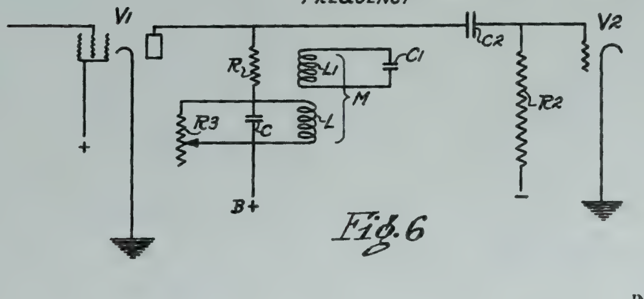



Fig. 6

INVENTOR
MURRAY G. CLAY

BY Richey & Watts
ATTORNEYS

## Anti-Backlash Dial

In this patent application filed on November 6, 1940, George Roethel stated the following:

*This invention relates to improvements in gears, and more particularly to an improved anti-backlash gear.*

*Gears for removing the play due to lost motion between the teeth are relatively well known. One such type of gear comprises a pair of plates held in juxtaposed position and having matching teeth on their peripheries. These plates are secured to a hub and are capable of movement on the hub relative to each other to cause displacement of the teeth thus widening or narrowing the teeth of the composite gear to take up any space in the gear train due to tolerances, wear or the like. It has been proposed to cause this relative movement by using a spring to move the composite gear parts in opposite directions. Heretofore this spring tension has been achieved by providing a pair of rectangular openings in the plates of the composite gear, which openings are offset relative to each other when the teeth in the two plates are aligned. Each opening In each gear is provided with one tongue which extends toward the center of the opening, and a helical spring is disposed over these tongues on the opposite plates during assembly. The spring causes the two plates to rotate in opposite directions until the two openings are aligned, at which time the teeth of the gears have been displaced relative to each other to cause the teeth of the composite gear to take up a larger space.*

*These prior springs had to be inserted in the openings provided in the gears during assembly of the gears before the two plates were secured to the hub. Thus after the gears were, assembled and before they were placed In the mechanism for which they were intended, a displacement of the teeth was realized which made it difficult to cause the teeth to mesh with the other gear.*

*By the present Invention the gear may be assembled without the springs and the parts secured to the hub in the usual manner after which the gear without the spring is disposed in its desired train and then the springs placed in position after the gear train is assembled.*

*It is therefore an object of this invention to provide an anti-backlash gear which is easier to assemble and one in which the displacing means for the sections of the gear may be inserted or removed without disassembling the gear.*

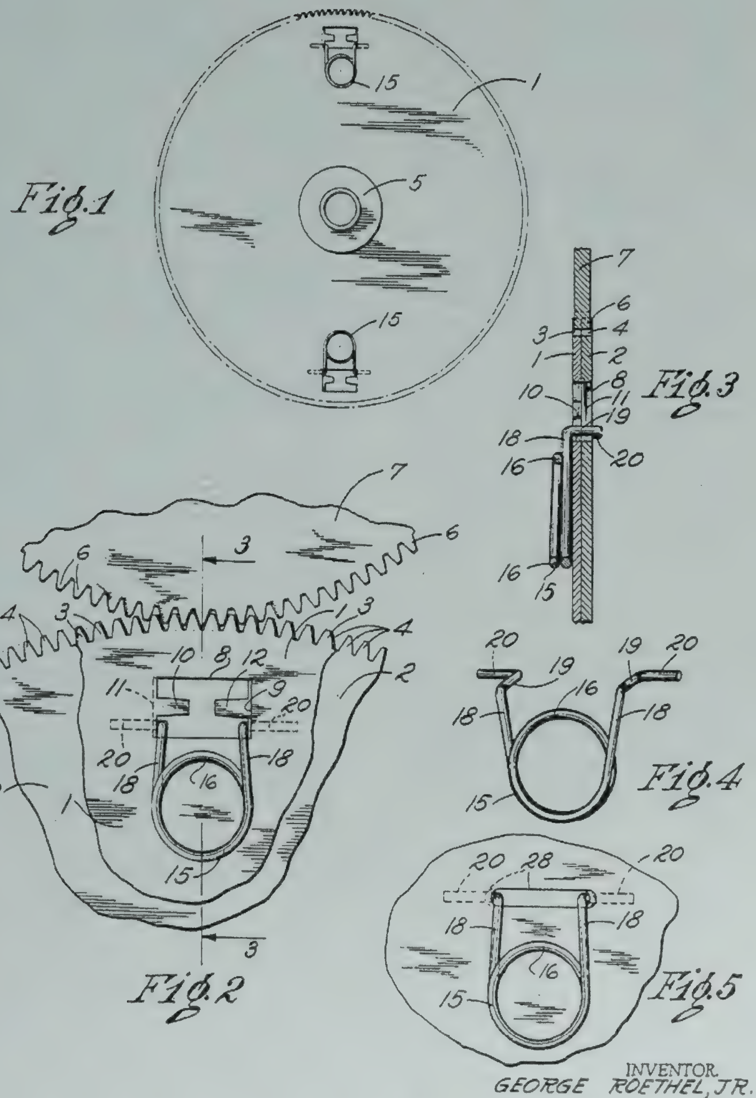
*Still another object of the invention results in a simplified construction which permits a more simplified gear resulting in economies in die costs, construction and provided for longer wearing dies.*

This dial was for receivers requiring precise tuning, such as the Communications receiver and the Navy receivers.

Feb. 23, 1943. G. ROETHEL, JR 2,311,902

ANTI-BACKLASH DIAL

Filed Nov. 6, 1940




INVENTOR.
GEORGE ROETHEL, JR.

BY

Richey & Watts
ATTORNEYS

## The Background Noise Suppressor

A U.S. patent application for this invention by Murray Clay was filed on November 5, 1937. Although a U.S. patent for this invention was not granted, a British patent was filed for on October 19, 1938 and was granted as British patent #519,486 on March 20, 1940.

Prior to 1937, a few patents were granted for methods to reduce the effect of noise from records. John Hayes Hammond, Jr. had a few such patents. Other patents were granted to inventors at RCA and Hazeltine, the principal patent holding corporations of that period. Sometimes these patents referred to "automatic tone control." However, none of them were incorporated into radio receivers for sale to the public.

In his application, Murray Clay wrote, *"In the ordinary manner of reproducing phonograph records through an amplifier, needle scratch is of course very objectionable. The advent of high fidelity amplification with extended frequency ranges and better phonograph pickup units has further aggravated this apparent unavoidable evil. The present patent relates to a special circuit for reducing the effects of needle scratch and other background noise to a minimum, where passages are of a low level order, and which allows full transmission without attenuation at, or above, a predetermined level".*

*"...with only low amplitude high frequency input voltages, corresponding to: scratch and surface noise from recordings, static and tube hiss from weak radio reception, or in general all sounds which are too weak to be heard without background noise, the higher audio frequencies are considerably attenuated before reaching the grid of the audio amplifier tube "V". On the other hand, it will be seen that with slightly higher amplitude high frequency input voltages the system automatically adjusts itself to permit the higher frequency input voltages to pass with less attenuation to the grid of the audio amplifier tube "V", while normal and high amplitude high frequency input voltages, corresponding to sounds which have sufficient volume to mask, "swamp", or "drown out" the undesired background noises are permitted to pass unattenuated to the grid of the audio amplifier."*

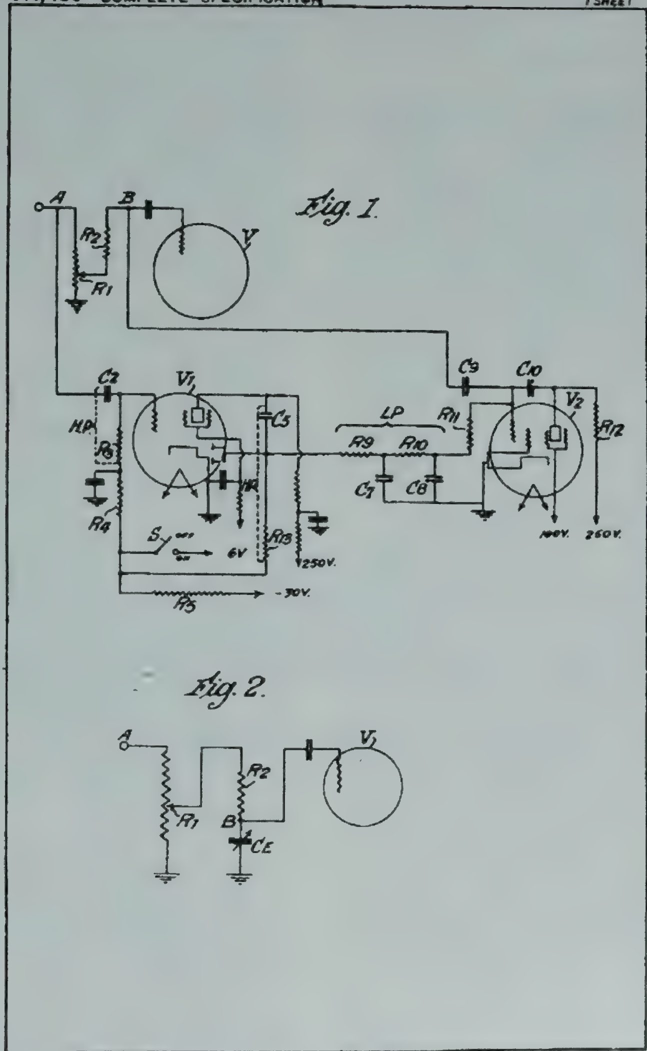
Figure 1 shows the circuit of the Dynamic Noise Suppressor in detail. Rather than list all of the values of the components here, one can read them from a circuit diagram of the Philharmonic. Figure 2 illustrates a simplified version of the circuit to explain its operation. V2 functions like a variable capacitor, $C_E$, connected to point B of Figure 1. $C_E$ is controlled by V1, which takes its input from point A, where the unaffected audio signal appears. $C_E$ increases at low audio levels and decreases at high audio levels.

Figures 1 and 2 are from this patent. In addition to a detailed description of the invention, it is stated in the patent that in effect an automatically varied capacity is provided in an audio circuit, the said capacity being controlled in dependence upon the strength of the higher audio-frequency signals.

The first "dynamic suppressor of record noise" was designed into the Scott Philharmonic and introduced in 1937.

The introduction of vinyl records at speeds of 33 1/3 and 45 rpm in the post-war period resulted in improved signal-to-noise ratios, but they were still 55 to 60 dB - somewhat below the level for optimum high fidelity reproduction. This need led inventors to continue their quest for record noise reduction.

519,486 COMPLETE SPECIFICATION 1 SHEET




(From British Patent #519,486)

## Sound Equalizer Reproducer System

Applying for this patent on December 24, 1940, Mr. Scott stated the following:

*"It has long been known that sound reproduced in loud speaker systems has directional characteristics. This is particularly true in the higher frequencies, and the higher the frequency of the sound, the more pronounced are its directional characteristics. Prior to comparatively recent years, this phenomenon was of no particular concern, since the average reproducer very seldom reproduced sounds over 3000 cycles. In more recent years, however, with the advent of high-fidelity, the directional characteristics of high frequency sound has become one of the problems for the acoustical engineer. With the modern frequency modulation stations putting signals on the air from 30 to 15000 cycles, it has become necessary to construct a sound system that will faithfully reproduce these signals.*

*Although the full range of frequencies may be reproduced, the full benefits therefrom are not always realized because of the before-mentioned directional characteristics to the sound. That is, although the low audio frequency sounds are heard in nearby parts of the room, the high frequency components of the sound are not in all parts because of the fact that they are projected in a beam only directly in line with the speaker and all concentrated in a relatively small area. This not only prevents them from being heard at points to one side of the loud speaker, but increases the intensity in the one area so that the sounds are too intense or are brassy in character. There are, therefore, only a very small number of places where one can sit in relation to the speaker and realize the full benefits of the high fidelity reproduction."*

This statement covered some improvements that needed to be made for better reproduction of high fidelity audio, but the invention did not provide a solution. The sound board blocked the high frequencies emanating from the cone, even though they were diffused.

The June 1944 issue of the SCOTT NEWS, published by the E.H. Scott Historical Society, contained an article by me titled "A Critique of the Tauscher Sound Board". A repetition of parts of the article will help to clarify the prior development of the Tauscher Board and its use prior to the invention of Patent #2,271,000.

### The Tauscher Patents

Arno E. Tauscher and Benno E. Schultze of Chicago, Illinois, not employees of Scott Radio Labs, filed patent applications on March 20, 1930 and September 5, 1930. They resulted in U. S. patents #1,812,998 and #1,839,714, respectively granted on July 7, 1931 and January 5, 1932. The first patent was titled "Resonance Attachment for Sound Reproducing Devices" and the second patent was titled "Amplifier for Sound Reproducing Devices".

The first and second paragraphs of patent #1,812,998 as shown below set forth the object of the invention.

*"This invention has for its objects to provide new and useful improvements in sound reproducing devices such as the loud or dynamic speakers of radio wave receiving apparatus commonly known as "radio sets" for the purpose of securing more accurate reproduction and to reduce the harshness of reproduced sound waves of such apparatus, and improving the tone quality of the instrument."*

*"More specifically, the object of the invention may be explained and defined as being intended to provide a series of sounding boards so relatively arranged and varied in dimensions as to be severally responsive to sound waves of different registers to thereby harmonize low, middle and high register sound waves to prevent some thereof being disproportionately loud or soft with respect to others except in so far as various notes are produced by voice, chorus, musical instrument or orchestra, etc."*

In the second patent in one version, the speaker was completely enclosed in a box with sides perforated by small openings looking like the f holes in a violin. In a second version of that patent, the speaker with the sound boards is fed into a horn type structure.

Although the Tauscher board was patented in 1931, for some reason it did not come to the attention of Mr. Scott until toward the end of 1939.

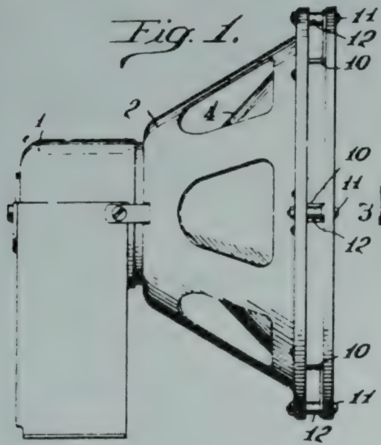
Until the time that Mr. Scott became interested in it, apparently it had found use primarily in hotel dining rooms and large restaurants. I recall that while eating in one of the dining rooms of the Edgewater Beach hotel, I looked up and saw Tauscher boards covering the loudspeakers of the music system installed there.

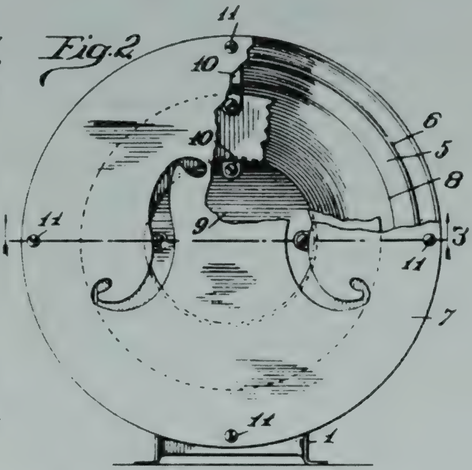
In the 1930's, noisy reproduction was common in public places because of phonograph record "scratch" and the generally poor quality of AM broadcasts. Whatever else the Tauscher board may have done to the sound reproduction, it reduced the output of the high frequencies and thus generally muted the tone. In

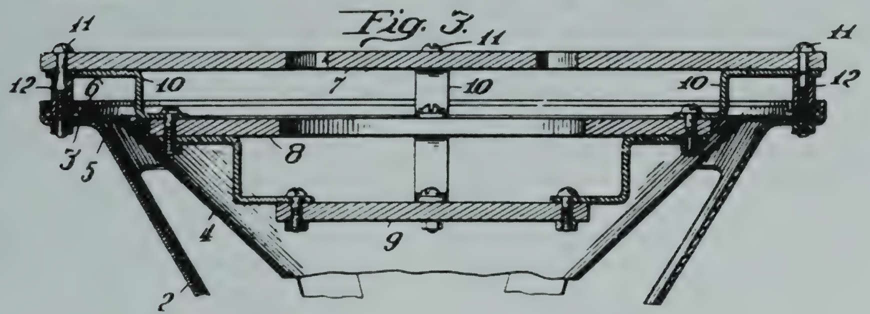
July 7, 1931. A. E. TAUSCHER ET AL 1,812,998

RESONANCE ATTACHMENT FOR SOUND REPRODUCING DEVICES

Filed March 20, 1930



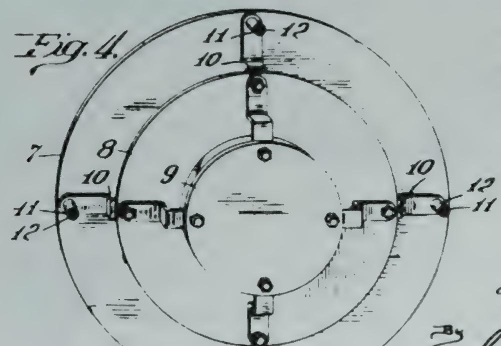




Figure 1 - Side elevation of speaker with Tauscher board

Figure 2 - Front elevation of speaker with Tauscher board

Figure 3 - Plan section along line 3-3 of Figure 2

Inventors:
Arno E. Tauscher
and Benno E. Schultze
By Rudolph [illegible]
Attorney

Figure 4 - Rear view of a series of sound boards or resonance elements detached from the speaker

Elements #1 to #12

1 Speaker magnet; 2 Speaker frame; 3 Annular frame flange; 4 Speaker cone; 5 Flexible washer
6 Inflexible washer; 7,8,9 Resonance elements; 10 Z-brackets; 11 Bolts; 12 Sleeves

restaurants and dining rooms this produced a more pleasant background, although it was not what a high fidelity enthusiast would enjoy. For this reason, I opposed its use and saw it as a backward step in Scott quality, where sales considerations dominated over technical perfection.

Mr. Scott was very interested in using the board. In the past he had chosen to call his product the "Stradivarius of Radio" and had used the violin as a logo. He saw the Tauscher board, with its violin f holes, to be the visible realization of this theme into his product. As a sales consideration, he saw it as a natural to show the Stradivarius concept translated into something more than just a symbol.

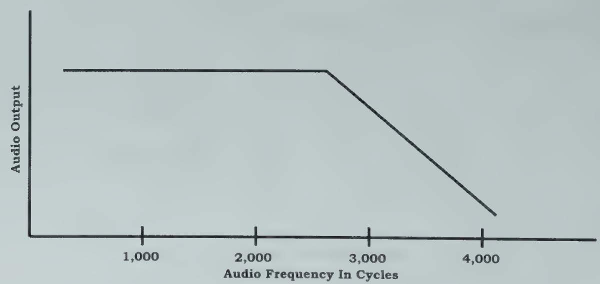
These inventions all reflected Mr. Tauscher's thinking that the audio output system of a radio should have a "tonal characteristic" of its own provided by resonant sound boards placed in front of the loudspeaker. While in some cases it may have enhanced the quality of some musical instruments, it ran counter to the principles of high quality sound reproduction from the radio. The most ideal receiver was supposed to deliver its output in a linear manner, unaffected by resonances of the speaker, cabinet, etc. Adding resonances in the form of boards in front of the loudspeaker certainly did not fit this concept. Although resonances can often be utilized to enhance low frequency reproduction, they should not have detrimental side effects. The undesirable side effect of the sound boards placed in front of the speaker was that they blocked the high frequencies emerging in a beam from and near the center of the cone. Of course, some high frequency output emerged through the openings in the board, but they were by no means in a pattern which could be called "uniform distribution". Even if it might have been, a significant loss of high frequency was not acceptable.

I was invited into the first meeting between Mr. Scott and Mr. Tauscher in 1939. Mr. Tauscher praised Mr. Scott for his accomplishments in sound reproduction and told how he thought that his sound board would add further enhancement to Scott products. As I recall, he also mentioned that he had installed several boards in leading hotel dining rooms and restaurants. Further meetings between Mr. Scott and Mr. Tauscher followed during which listening tests were made and detailed arrangements for a supply of boards were made. The use of the Tauscher board in Scott products was announced in glowing terms by Mr. Scott in the Scott News, Volume 12. Number 3 in 1940.

As I mentioned above, I was particularly unhappy about the use of the Tauscher board, because at the time it was introduced by Mr. Scott, we were also introducing our FM products. The reception and reproduction of audio derived from FM was definitely a step in the direction of true audio reproduction up to a frequency of 15000 cycles. the use of the Tauscher board was a step in the opposite direction, because it reduced the high frequency output of the speaker, which it covered. In the speaker system which we were using in our top models, it resulted in a "sway-backed" reproduction curve. This occurred because the high frequency speakers did not have much response in the range between 3000 and 6000 cycles. There was no question that the board redistributed the high frequency output of the speaker which it covered, but it also severely reduced their level.

I made measurements on the output of a receiver with a Tauscher board using a microphone and feeding the receiver with a range of audio frequencies. I no longer have copies of those output measurements, but in general the response was like that shown in the diagram below. I made a report of these measurements to Mr. Scott and told him that the Tauscher board had an undesirable affect on the high frequencies, but I think he had already committed to proceed with the use of the board.

It then followed that many Scott receivers shipped during part of 1940 and all of 1941 were equipped with the Tauscher boards. My efforts to have products which truly reflected the high quality possible with FM were thwarted.




**Audio Response of Typical Loudspeaker Equipped With Tauscher Sound Board**

Jan. 27, 1942. E. H. SCOTT 2,271,100

SOUND EQUALIZER REPRODUCER SYSTEM

Filed Dec. 24, 1940

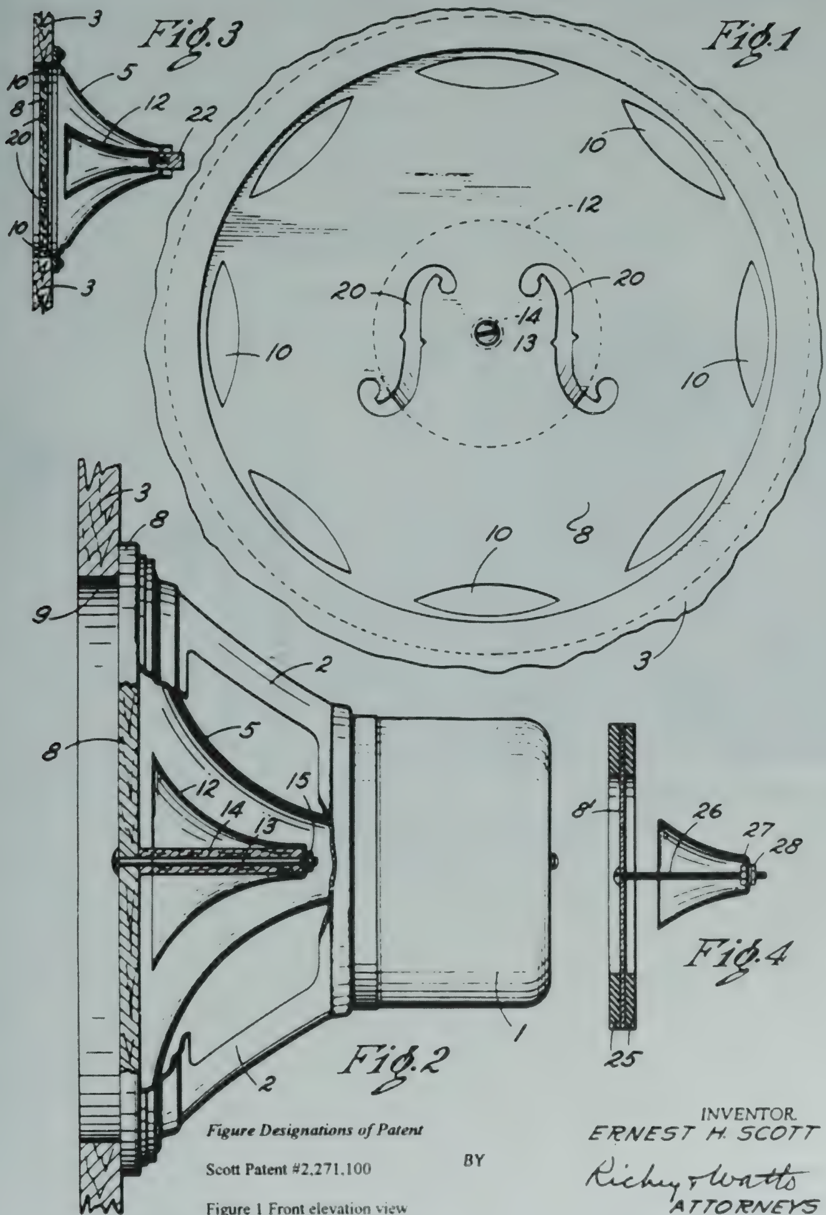



***Figure Designations of Patent***

Scott Patent #2,271,100

Figure 1 Front elevation view

Figure 2 Side elevation view

Figure 3 Fragmentary section of a modifying form of the invention

Figure 4 Another section of a third modification

Elements #1 to #28

1 Speaker pot; 2 Speaker frame; 3 Baffle board of the cabinet; 5 Speaker cone; 8 Sound board; 9 Hole in cabinet; 10 Elliptical openings in the sound board; 12 Diffuser cone; 13 Mounting bolt for diffuser cone; 14 Bushing; 15 Nut for diffuser cone mounting bolt; 20 Openings in sound board like *f* holes in violin; 25 Support blocks for sound board; 26,28 Mounting bolt and nuts for sound diffuser; 4,6,7,11,16,19,21,24 Not designated

Mr. Scott's patent was granted on January 27, 1942. I had already left the Laboratories at that time to work for the government during World War II on a one year leave of absence. I did not return for one full year and never saw this patent until some years later. Mr. Scott had not consulted me at any time about it, and from 1942 to 1945 practically all of my effort was toward meeting military requirements. After Mr. Scott passed away during the 1950's, Mrs. Scott wrote to me about it, but there was little that I could do with it because of the many changes which had taken place in the company. As far as I know, Mr. Scott's version of the board was never installed on any Scott receivers sold to the public.

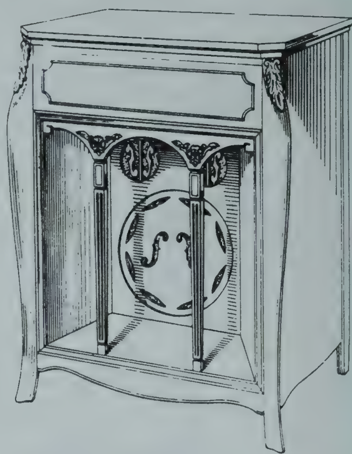
A. C. Haggstrom, of Rockford, Illinois, who designed and built Scott cabinets before World War II was not left out of the picture. He obtained at least two design patents for cabinets showing the sound board which looked like Mr. Scott's version. One of these is shown below.

E.H. Scott and Arno Tauscher

March 25, 1941. A. C. HAGGSTROM Des. 126,070

LOUDSPEAKER CONSOLE

Filed Jan. 2, 1941



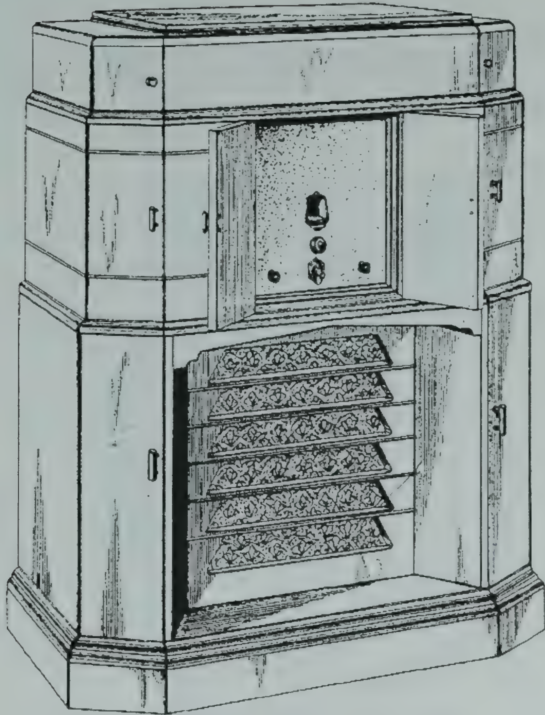
March 14, 1933.

A. C. HAGGSTROM

Des. 89,441

RADIOCABINET

Filed Dec. 24, 1932



Inventor

ARTHUR CHAS. HAGGSTROM

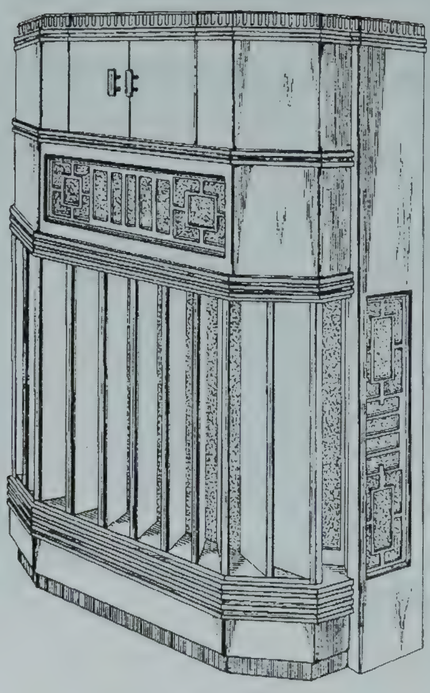
By Richey & Watts

Attorneys

June 25, 1935. A. C. HAGGSTROM Des. 96,036

RADIOCABINET

Filed May 9, 1935



Inventor

ARTHUR CHAS. HAGGSTROM

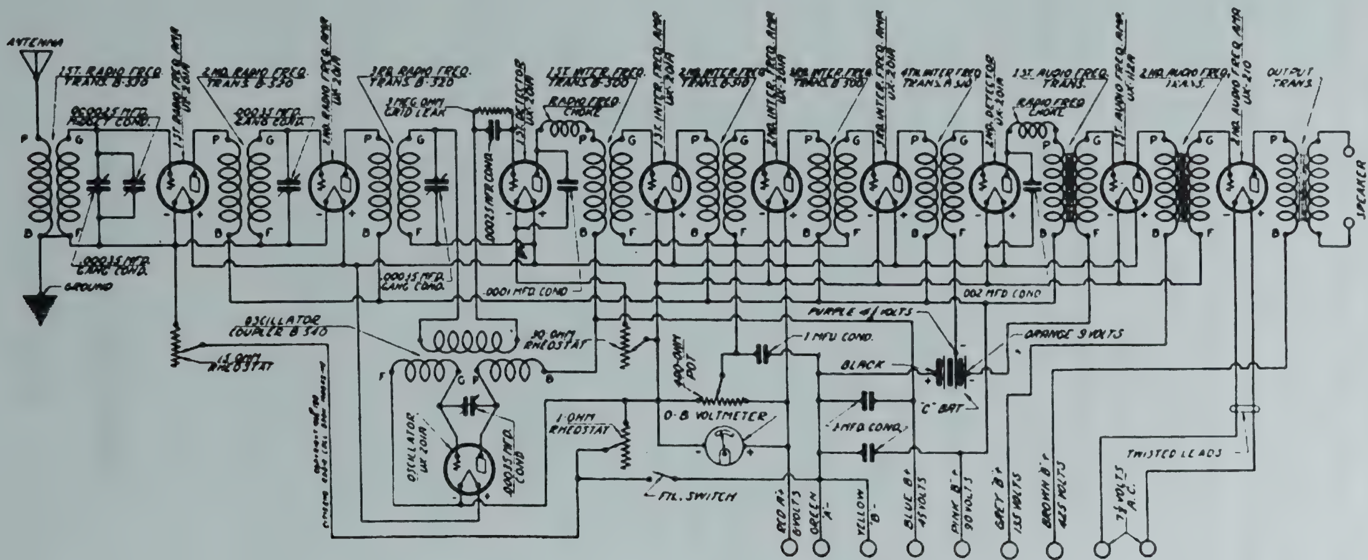
By Richey & Watts

Attorneys

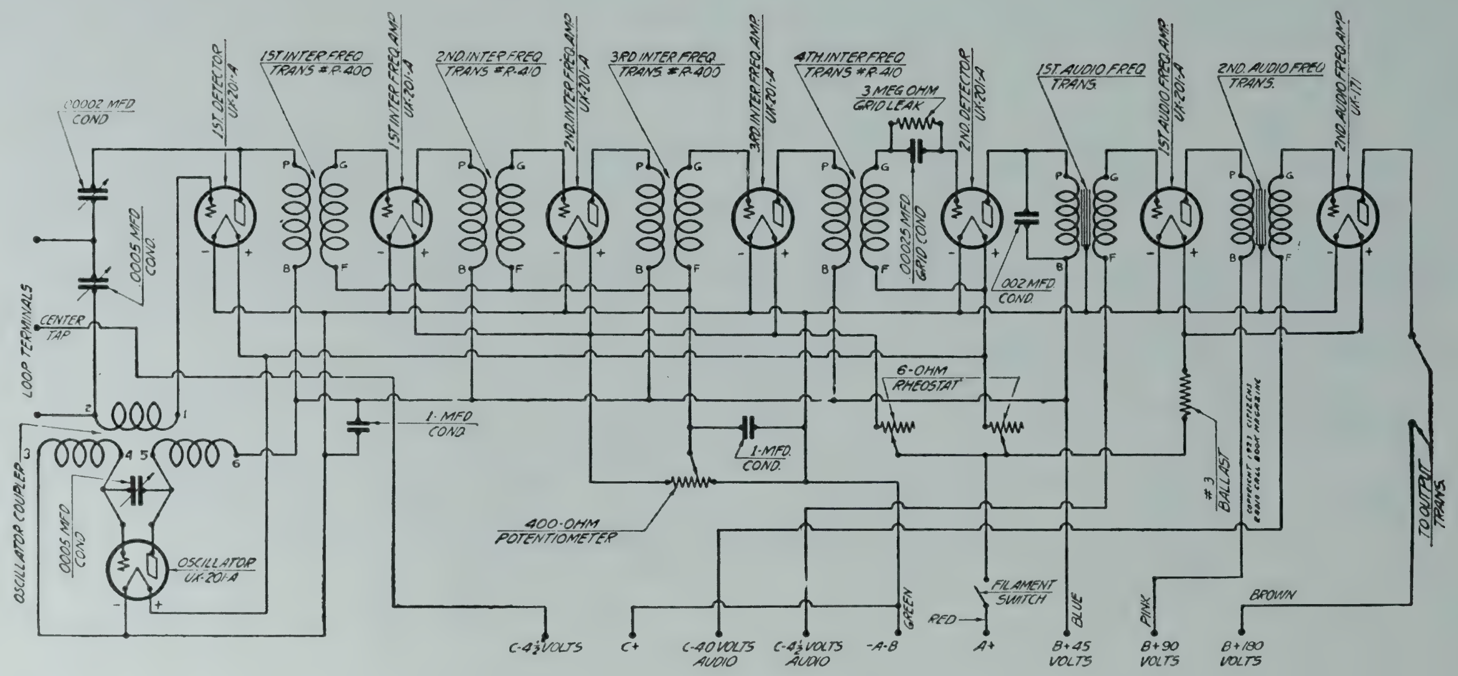
## *Appendix B*

# Circuit Diagrams

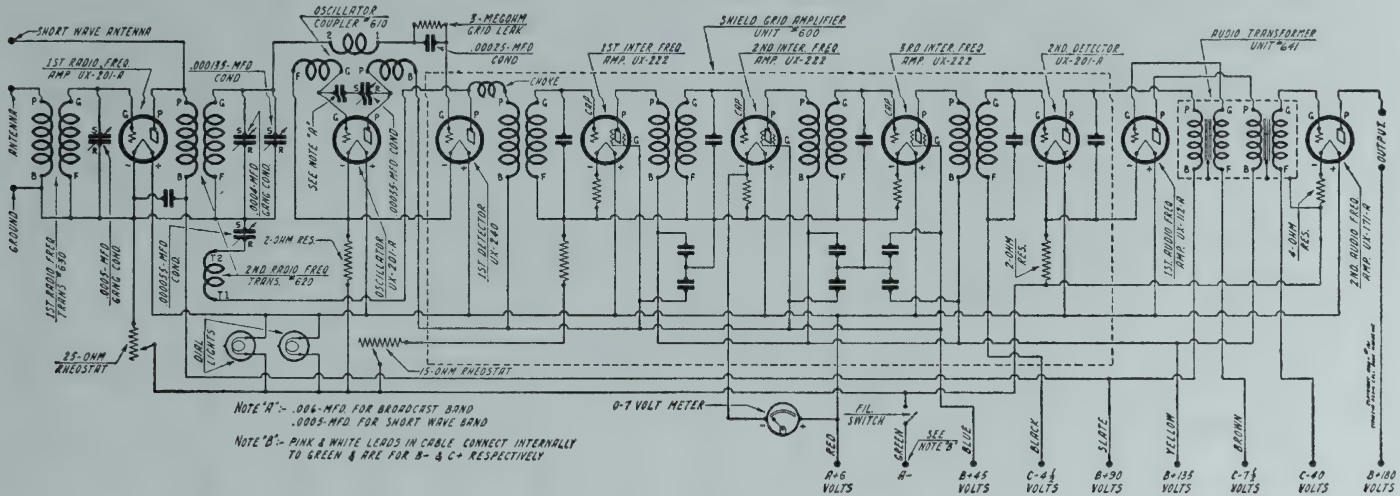
The following schematic diagrams are provided to give a general indication of the technical design of any given Scott receiver model. These diagrams were derived from documents 50-75 years old and are of varying quality. They are presented in chronological order from earlier to later designs/models. Schematics of Scott products after my departure in 1947 are not included. Because early designs were kits, later models were custom built products, and circuit improvements and advances were often incorporated, many variants of Scott schematics exist



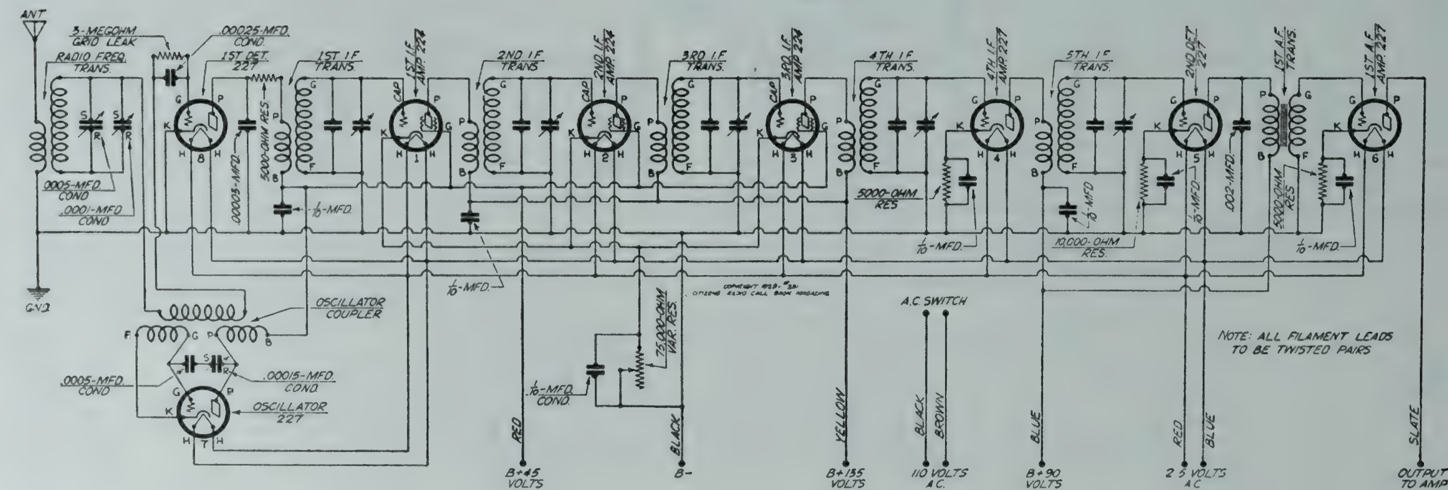

Scott "World's Record 10" Receiver



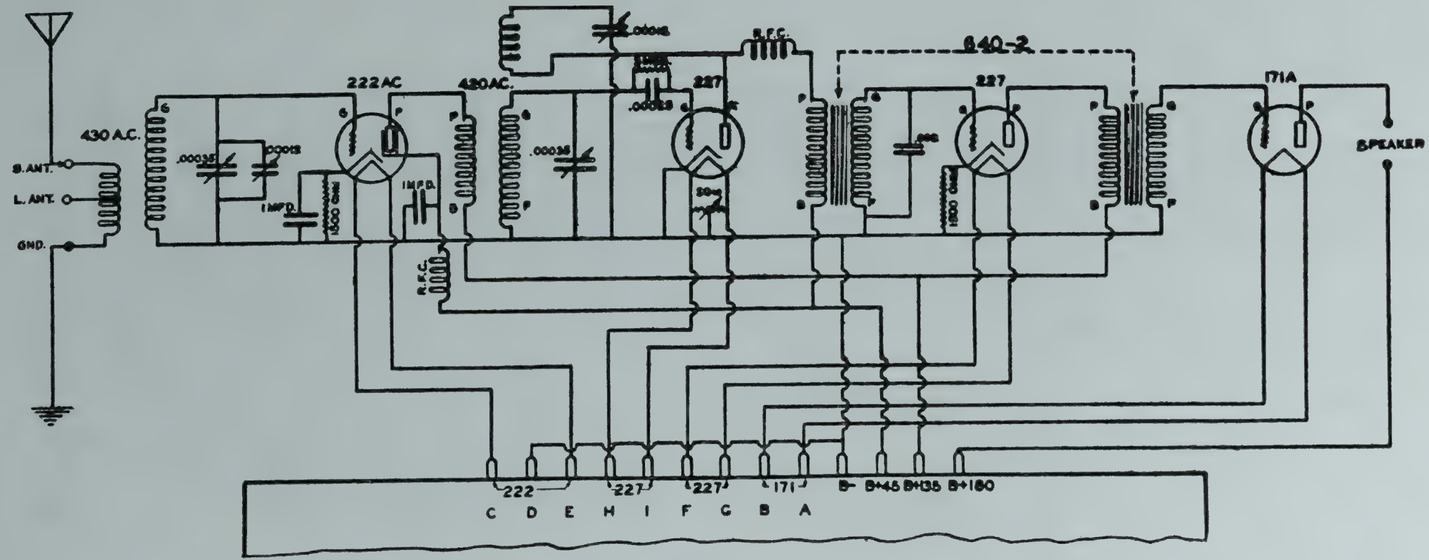

Scott "World's Record 8" Receiver (1928 Version)



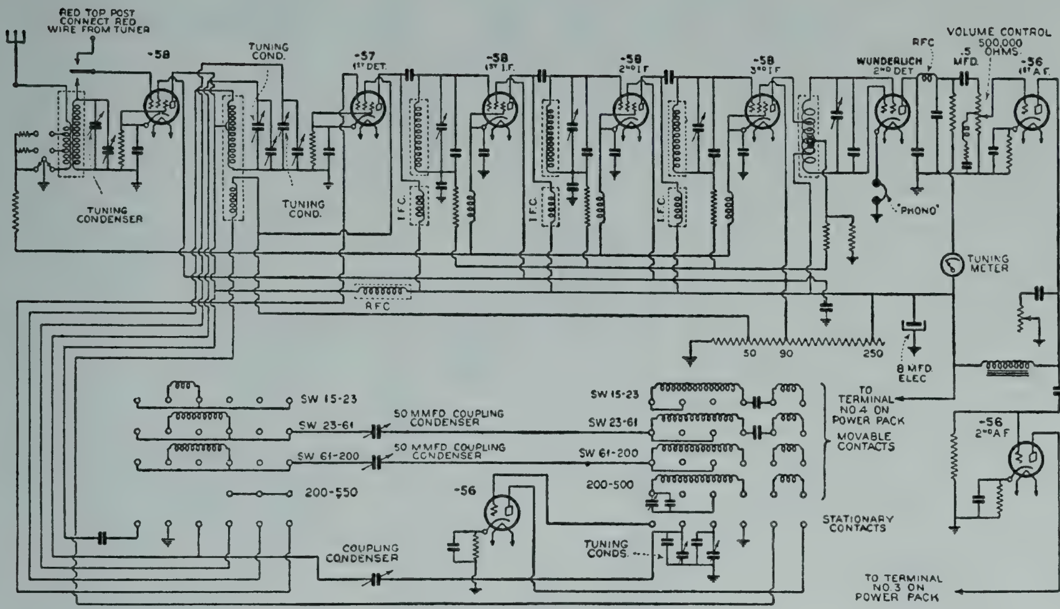

Scott Shield Grid 9B Receiver

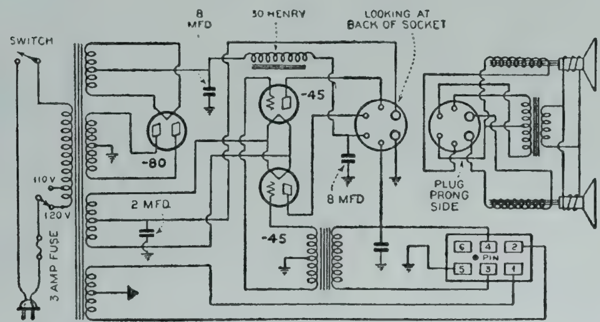



Scott Shield Grid A.C. 10 Receiver

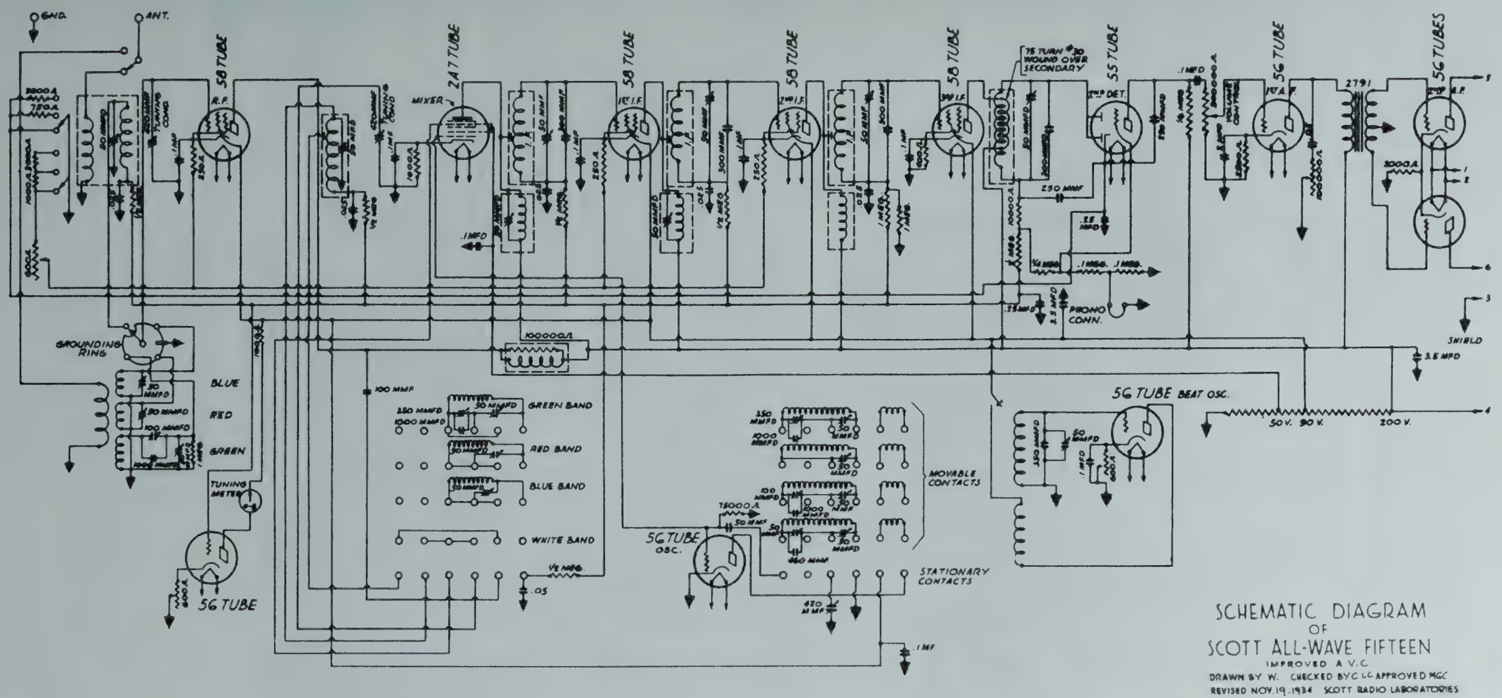



Scott Symphony Receiver

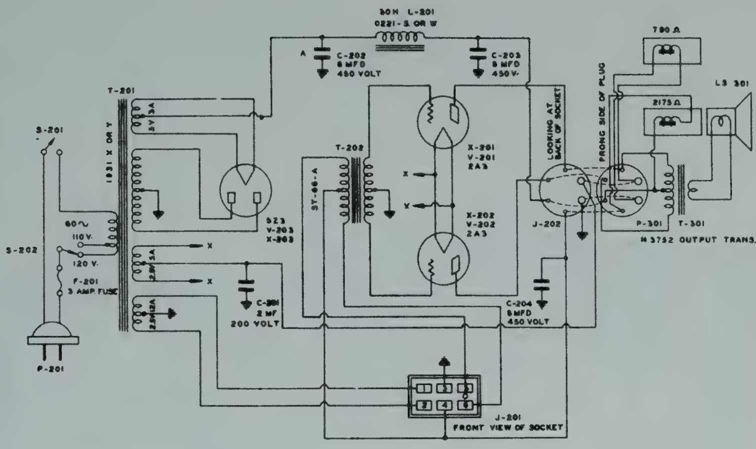



**Scott ALLWAVE 12 Deluxe Receiver w/AVC (top)**
**and**
**Power Supply/Audio Power Amplifier (bottom)**

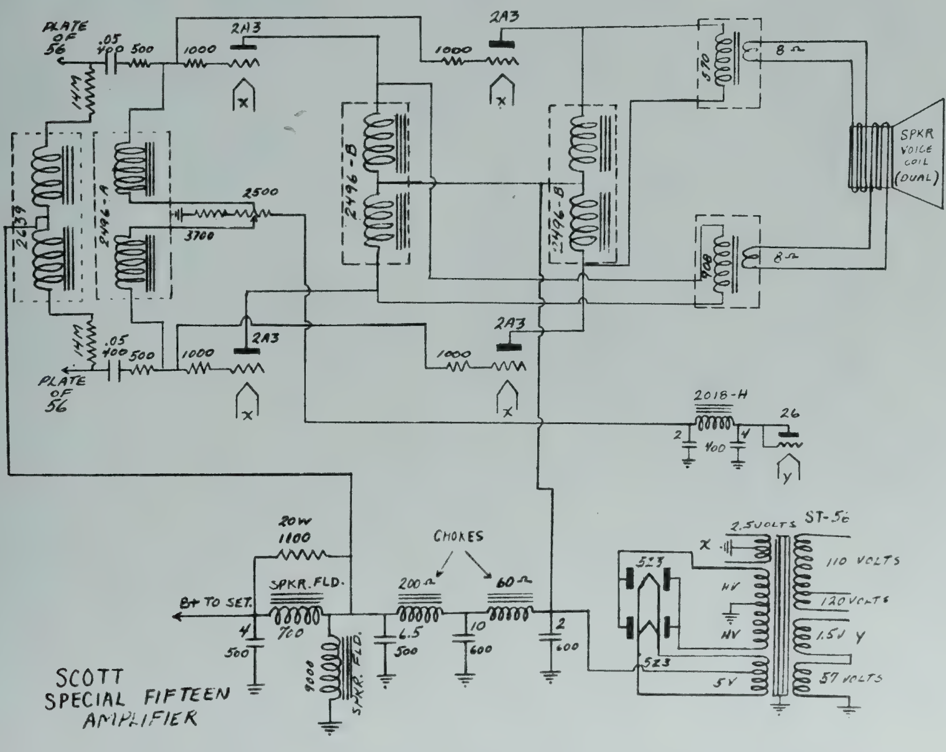



Scott ALLWAVE 15 Receiver



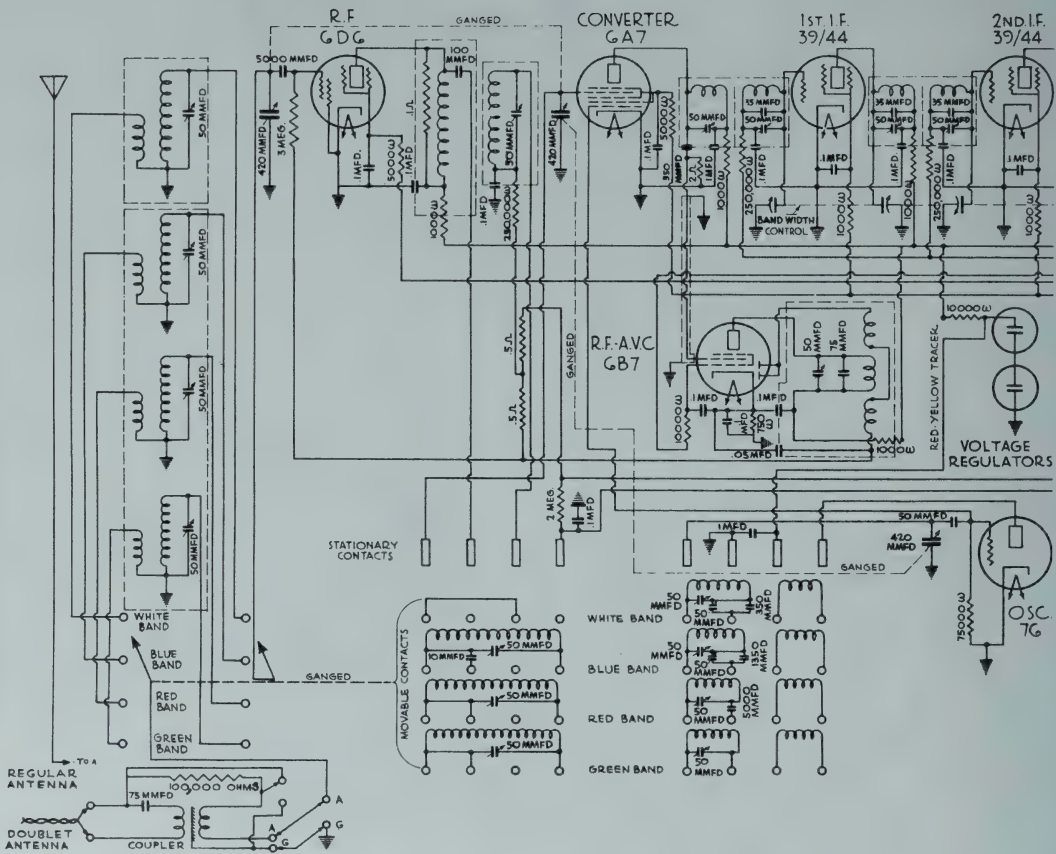

SCOTT ALLWAVE FIFTEEN AMPLIFIER

4-3-46
M.L.C.

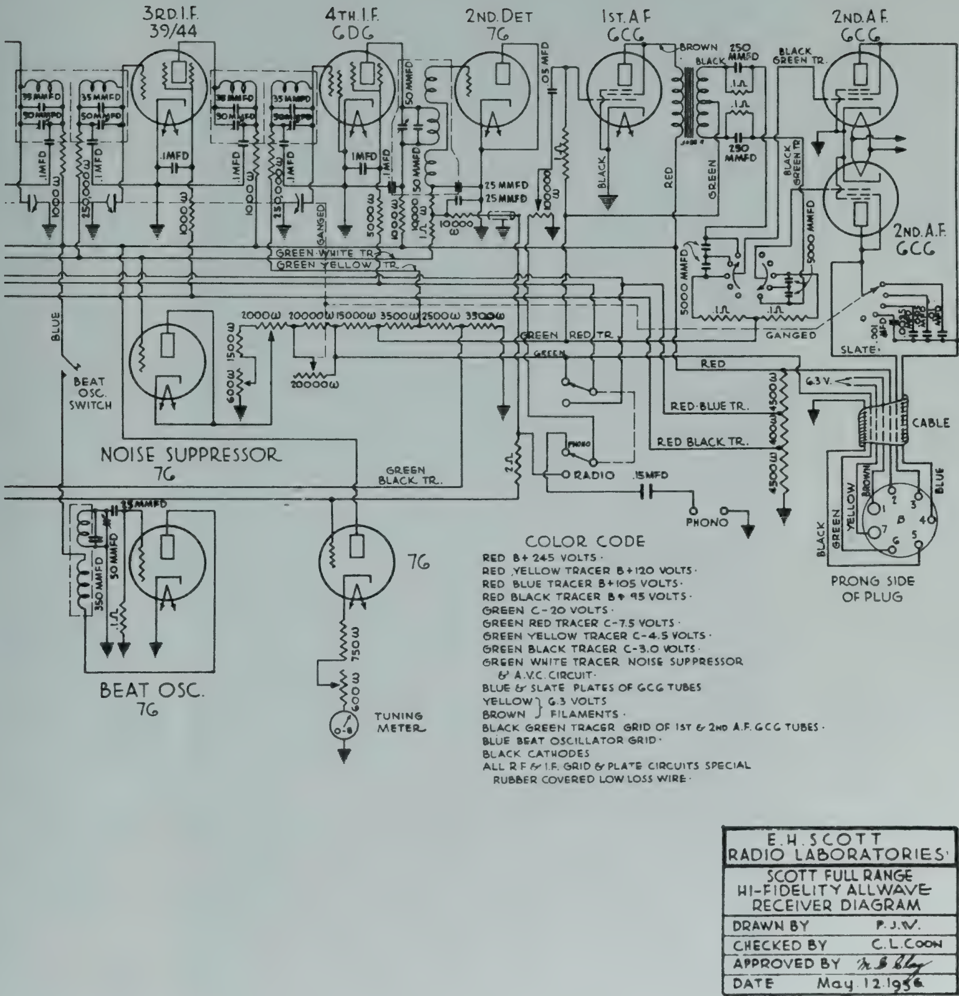



**Scott ALLWAVE 15 Power Supply/Audio Power Amplifier (Top)**

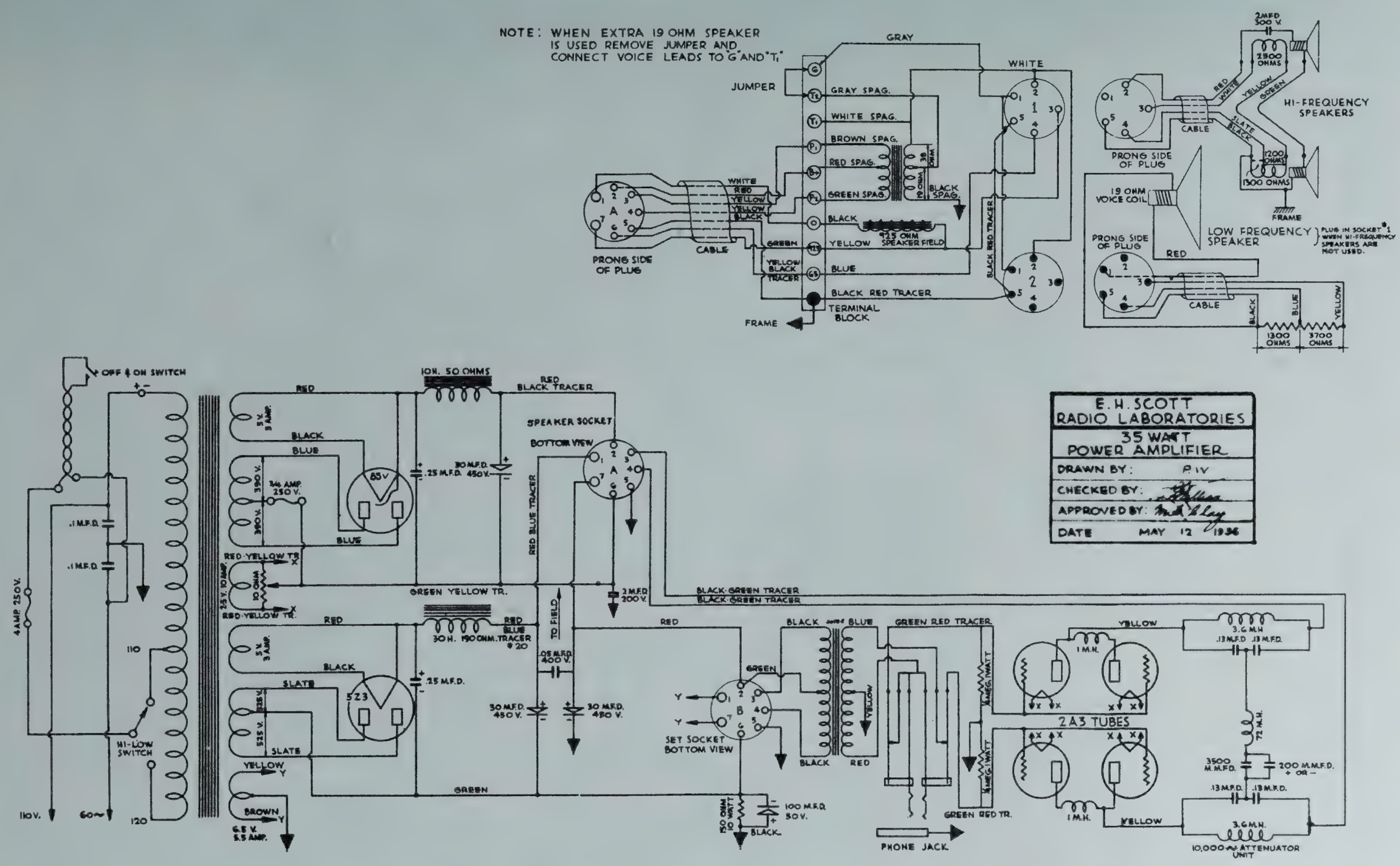
**Scott ALLWAVE 19 Power Supply/Audio Power Amplifier (Bottom) Mated With ALLWAVE 15 Receiver On Prior Page To Become ALLWAVE19**



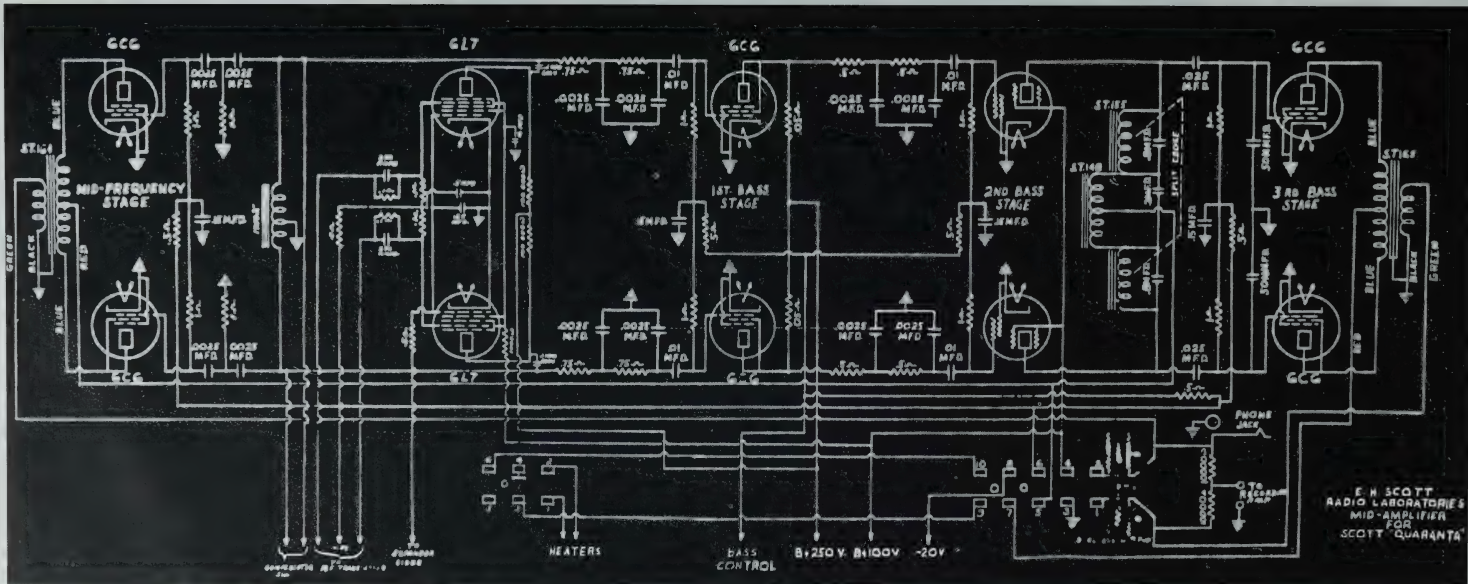

ALLWAVE 23 (Scott Full Range High Fidelity) Receiver (Part I)



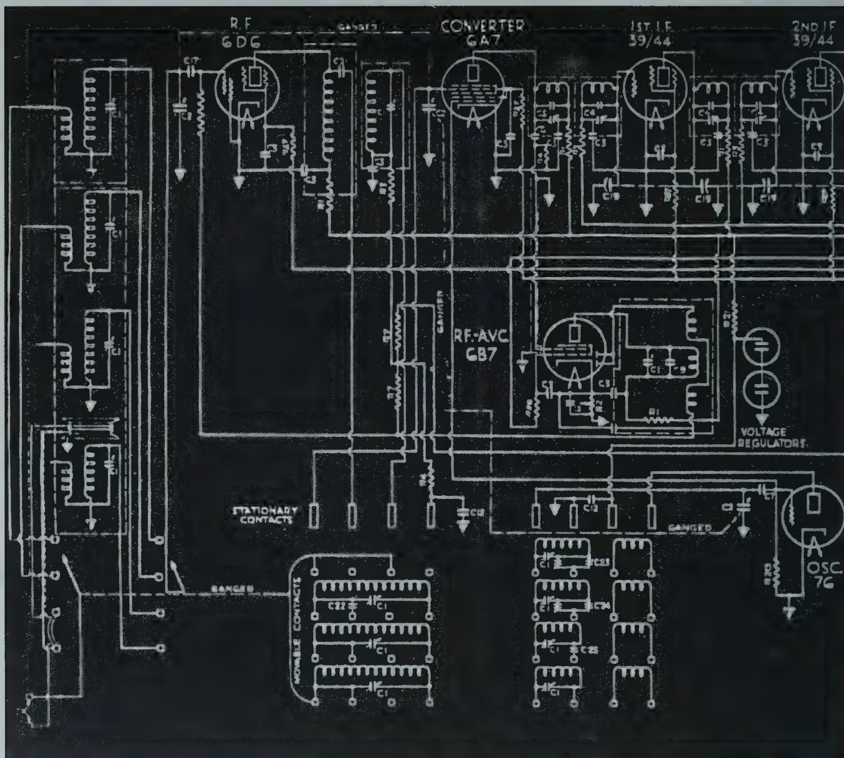

**ALLWAVE 23 (Scott Full Range High Fidelity) Receiver (Part II)**



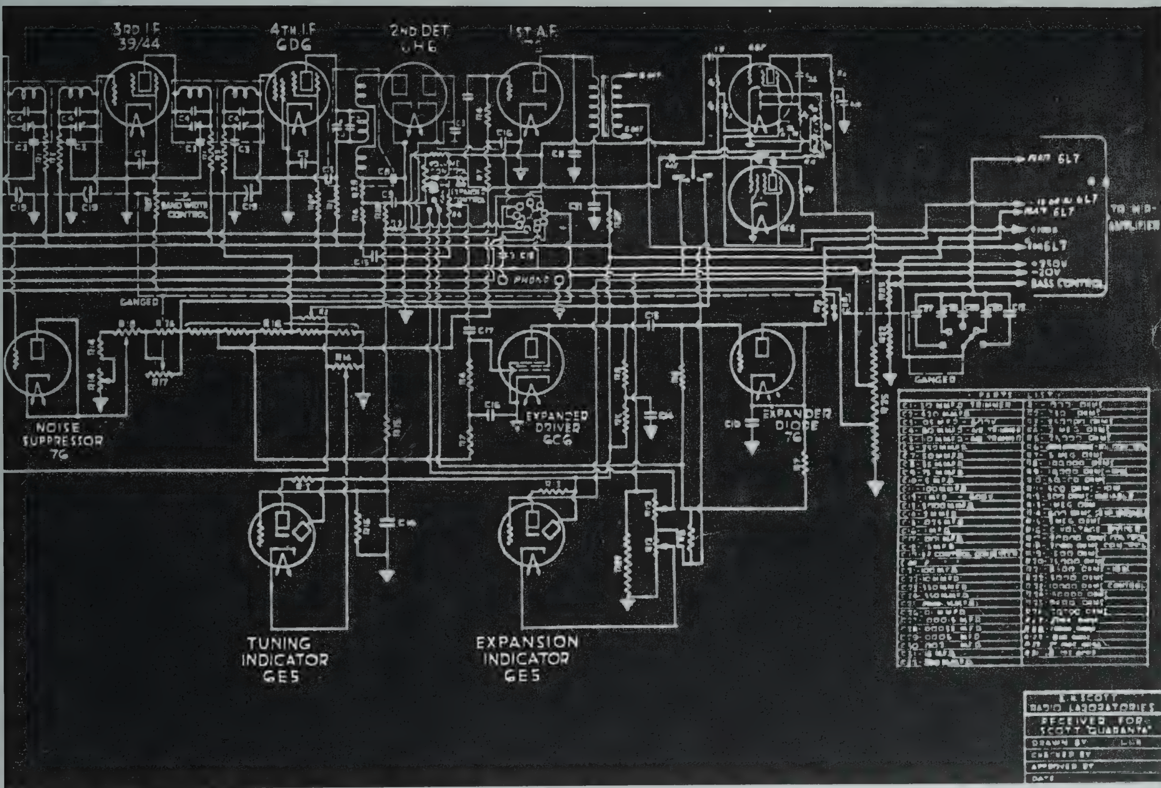

Scott ALLWAVE 23 Power Supply/Audio Power Amplifier and Speaker Interconnection




Quaranta Mid-Amplifier




Quaranta Receiver (Part I)




Quaranta Receiver (Part II)

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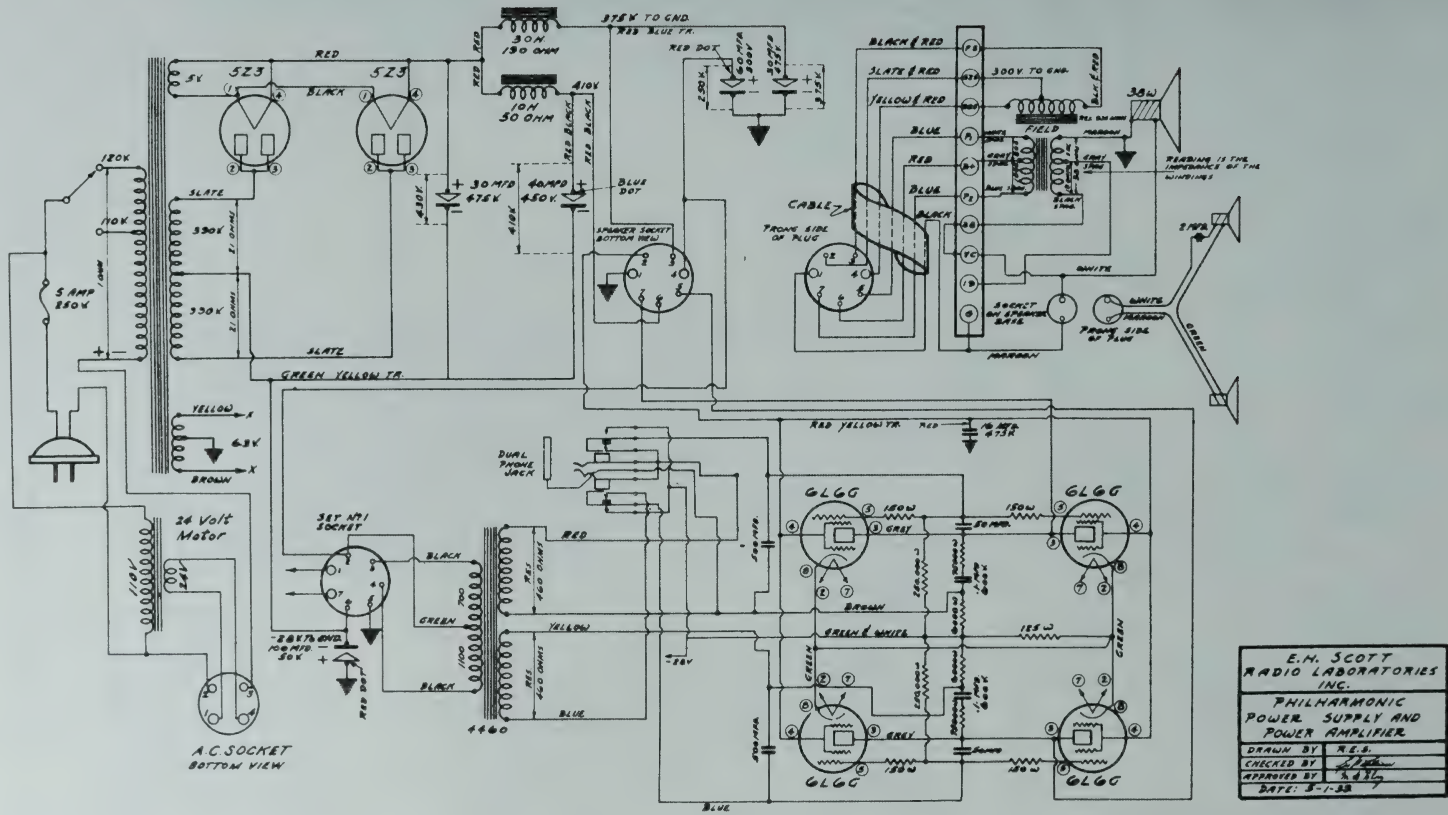
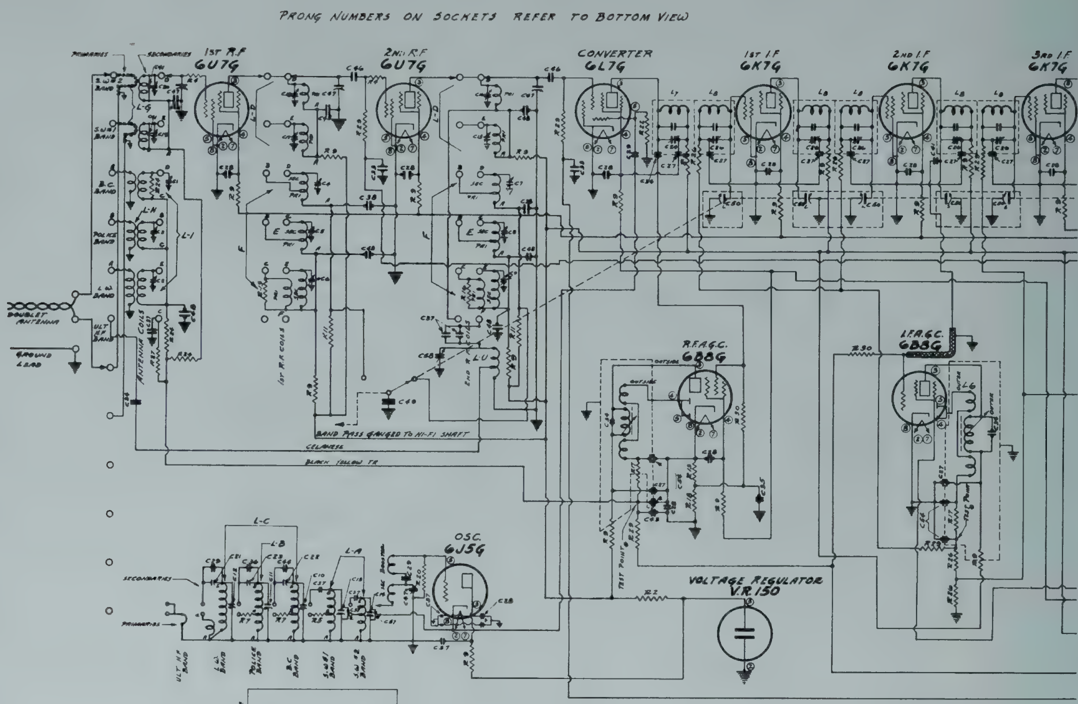
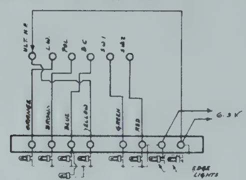



Scott AM Philharmonic Power Supply/Audio Power Amplifier and Speaker Interconnection




## COLOR CODE

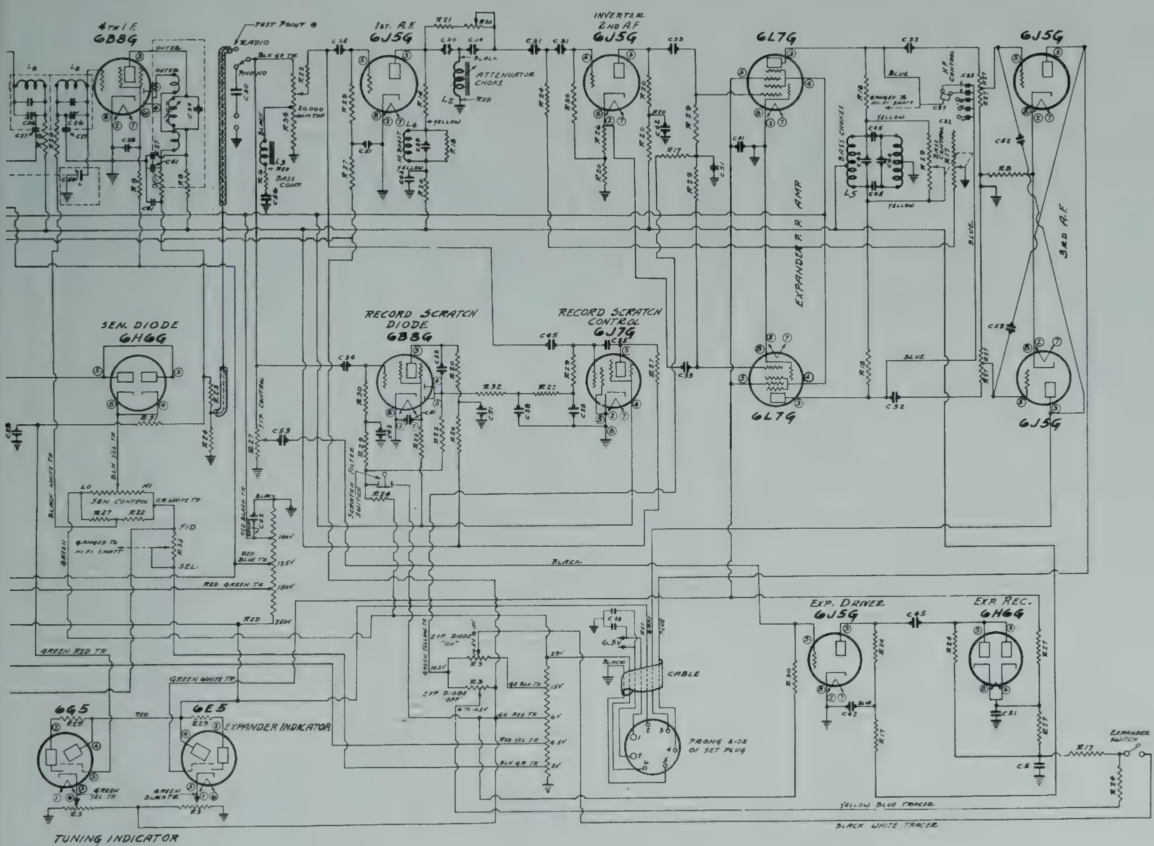
RED B+ 250V.
RED GREEN TRACER B+150V.
RED BLUE TRACER B+125V.
RED BLACK TRACER B+100V.
GROUND BLACK
GREEN C-29V.
GREEN BLACK TRACER C-15V.
BLACK WHITE TRACER C-13.5V

GREEN YELLOW TRACER C-10.5V
GREEN RED TRACER C-6V.
RED YELLOW TRACER C-4.5V.
BLACK GREEN TRACER C-3V
FILAMENTS YELLOW AND BROWN
PLATES 3RD AUDIO 6J5G BLUE SLATE
EXPANDER GRIDS BLACK
ALL R.F AND I.F. GRID AND PLATE
CIRCUITS SPECIAL RUBBER
COVERED LOW LOSS WIRE

* "TEST POINT" INDICATES POINT WHERE HIGH RESISTANCE METER IS CONNECTED FOR I.F. ALIGNMENT

**Scott AM Philharmonic Receiver (Part I)**

PRONG NUMBERS ON SOCKETS REFER TO BOTTOM VIEW

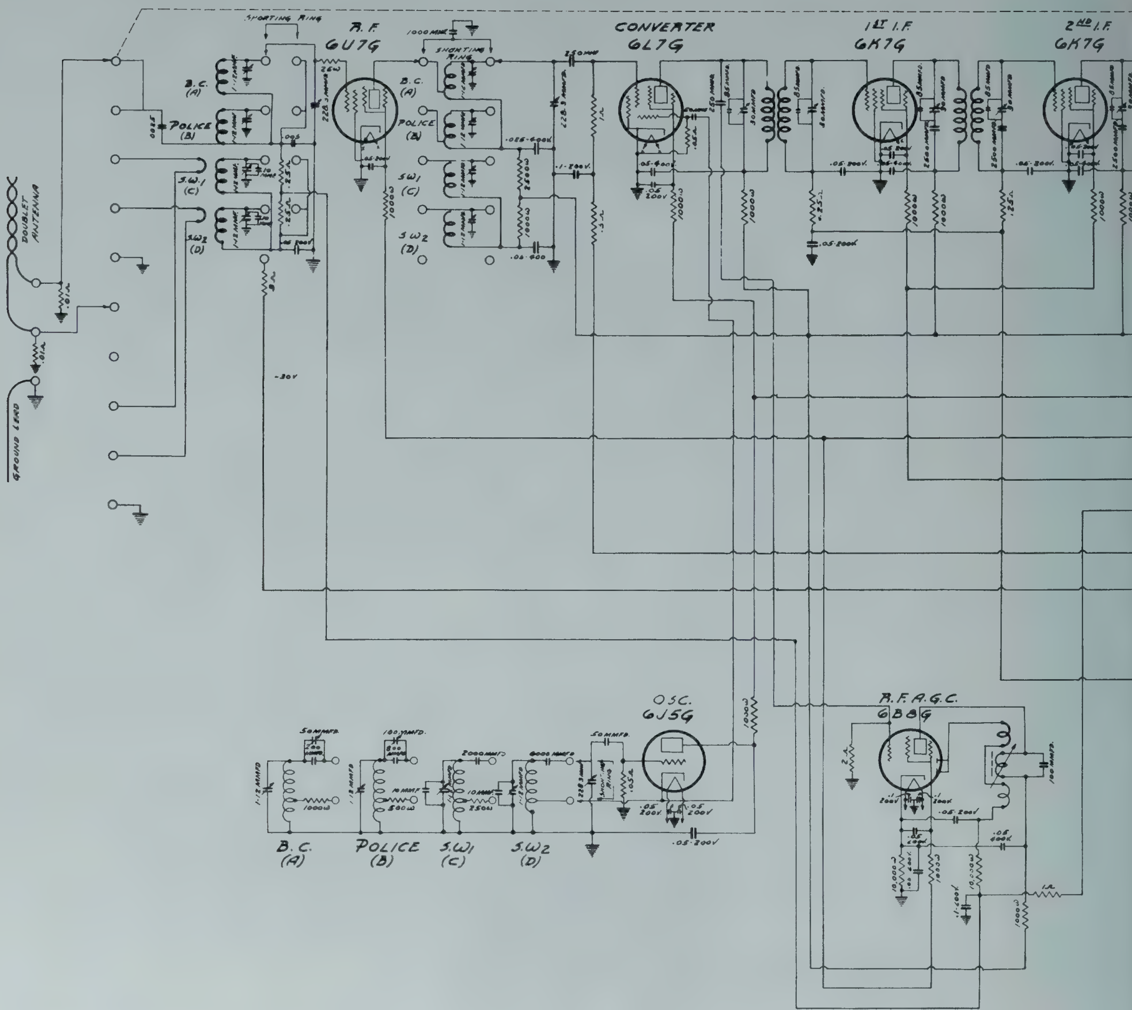



| | |
|---|---|
| C1 TO C20 1-12 | R1-125 OHMS 10 WATTS |
| C21 TO C23-100 MMFD AIR | R2-6500 OHMS 2 WATTS |
| C24-85 MMFD & 30 MMFD. | R3-300 OHMS (VARIABLE) |
| C-26 60 MMFD AIR | R4-25 OHMS 1/4 WATT |
| C-26 30 MMFD AIR | R5-100 OHMS 1/4 WATT |
| C27-.05 MFD 400V. | R6-150 OHMS 1/4 WATT |
| C28-.05 MFD. 200V. | R7-500 OHMS 1/4 WATT |
| C29-50 MMFD. MICA | R8-800 OHMS 1/4 WATT |
| C30-.1 MFD. 600V | R9-1000 OHMS 1/4 WATT |
| C31-6000 MMFD MICA | R10-1600 OHMS 1/4 WATT |
| C32-2500 MMFD MICA | R11-2500 OHMS 1/4 WATT |
| C33-.01 MFD 400V. | R12-3000 OHMS 1/4 WATT |
| C34-100 MMFD MICA | R13-3500 OHMS 1/4 WATT |
| C35-.01 MFD 200V | R14-5000 OHMS 1/4 WATT |
| C36-300 MMFD MICA | R15-6000 OHMS 1/4 WATT |
| C37-5000 MMFD MICA | R16-7500 OHMS 1/4 WATT |
| C38-8000 MMFD MICA | R17-10000 OHMS 1/4 W. |
| C39-500 MMFD MICA | R18-15000 OHMS 1/4 W. |
| C40 .02 MFD 400V | R19-20000 OHMS 1/4 W |
| C41-25 MMFD. MICA | R20-25000 OHMS 1/4 W. |
| C42-4 MFD 300V. | R21-40000 OHMS 1/4 W. |
| C43-.1 MFD 200V | R22-50000 OHMS 1/4 W. |
| C44-900 MMFD MICA | R23-75000 OHMS 1/4 W. |
| C45-.025 400V | R24-100000 OHMS 1/4 W. |
| C46-250 MMFD MICA | R25-200000 OHMS 1/4 W. |
| C47-320 MMFD CANS | R26-250000 OHMS 1/4 W. |
| C48-.1 MFD 400V. | R27-500000 OHMS 1/4 W |
| C49-.15 MFD 400V. | R28-750000 OHMS 1/4 W |
| C50-H.F. CONTROL | R29-1000000 OHMS 1/4 W. |
| C51-7X.5 } 400V 400V. | R30-2000000 OHMS 1/4 W. |
| C52-5 MMFD MICA | R31-3000000 OHMS 1/4 W. |
| C53-1000 MMFD MICA | R32-75000 OHMS 1 W. |
| C54-2X.005 MFD. 200V | R33-2000 OHM CONTROL |
| C55-35 MMFD. MICA | R34-500000 OHM CONTROL |
| C56-1 MFD 200V | |
| C57-20 MMFD MICA | L2-1 HENRY CHOKE |
| C58-50 MMFD. MICA | L3-24 M H. CHOKE |
| | L4 .7 HENRY |
| | L5-175 HENRY |
| | L6 DIODE COIL |
| | L7 .8 MH |
| | L8 1.2 MH |
| | |

| |
|---|
| |
| L-A SW1 AND SW2 OSC. COIL |
| L-B POLICE OSC. COIL |
| L-C LW AND B.C. OSC. COIL |
| L-G SW1 AND SW2 ANT COIL |
| L-H POLICE ANT COIL |
| L-1 LW AND BC ANT COIL |
| L-D SW1 AND SW2 RF1 AND RF2 COILS |
| F LW AND B.C RF1 AND RF2 COILS |
| E POLICE RF1 AND RF2 COILS |
| |
| |
| |

| | |
|---|---|
| E.H. SCOTT RADIO LABORATORIES INC. | |
| PHILHARMONIC RECEIVER DIAGRAM | |
| DRAWN BY: | R.E.S. |
| CHECKED BY: | [illegible] |
| APPROVED BY: | [illegible] |
| DATE: | MAY 15, 1937. |

**Scott AM Philharmonic Receiver (Part II)**



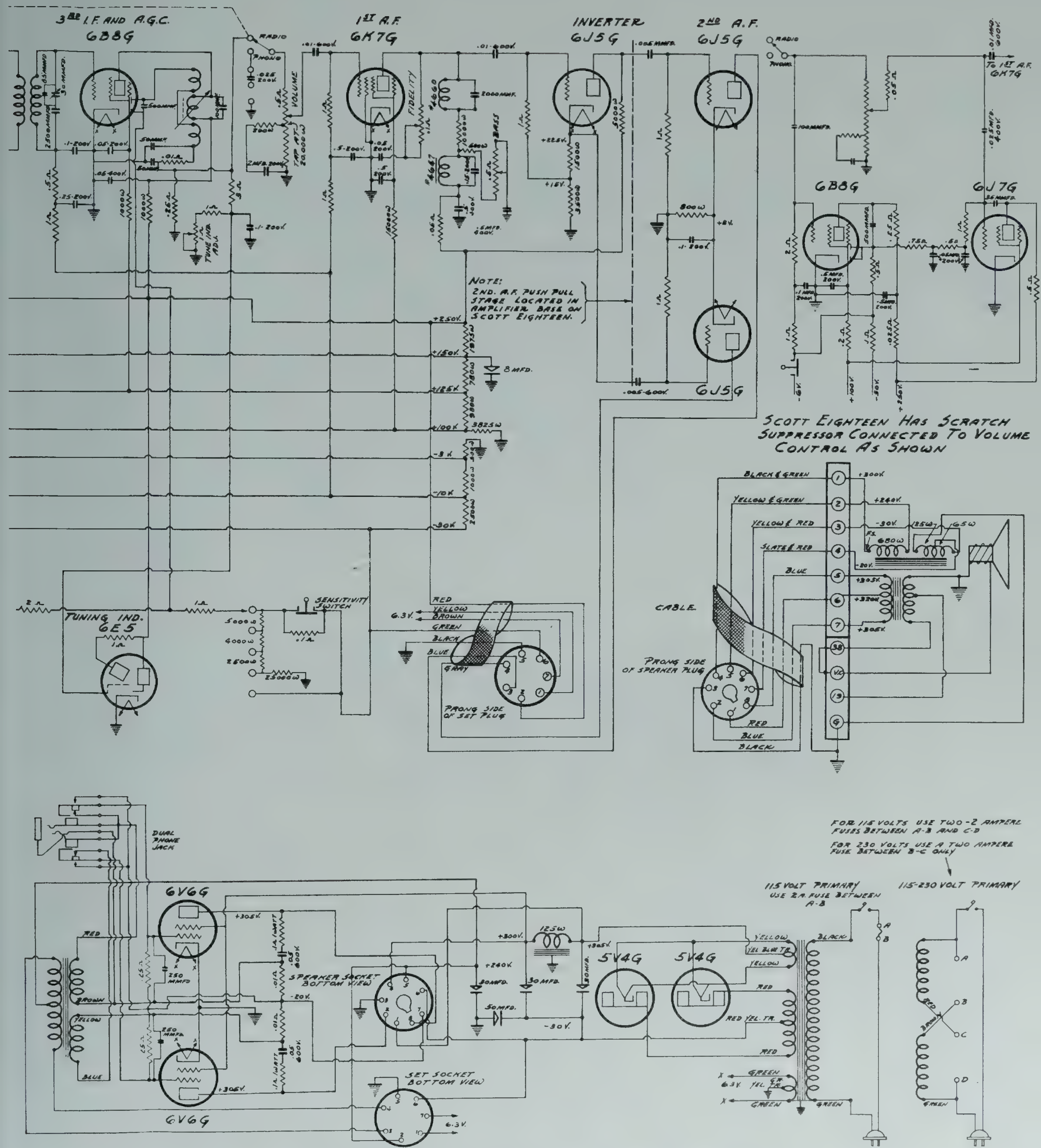

E.H. SCOTT RADIO LABORATORIES INC.

CIRCUIT DIAGRAM OF
SCOTT SIXTEEN
ALSO SCOTT EIGHTEEN

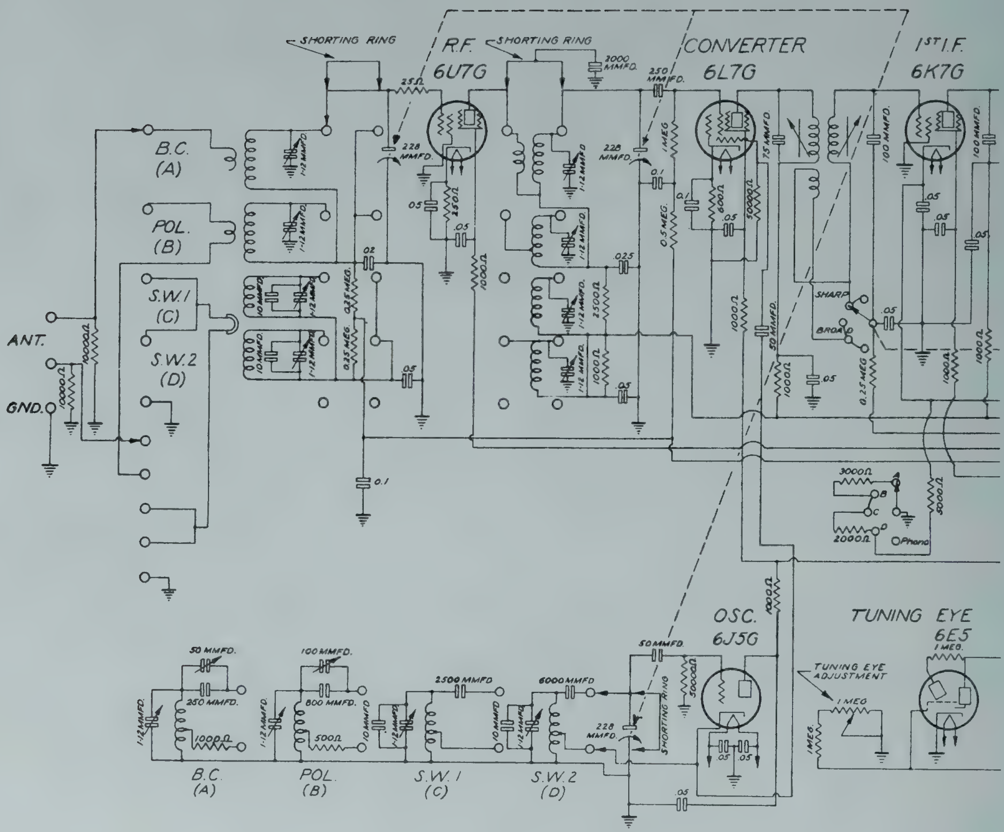
AUGUST 19, 1937

| | |
|---|---|
| DRAWN BY | R.E. STRAND |
| CHECKED BY | C.L. Cook |
| APPROVED BY | |

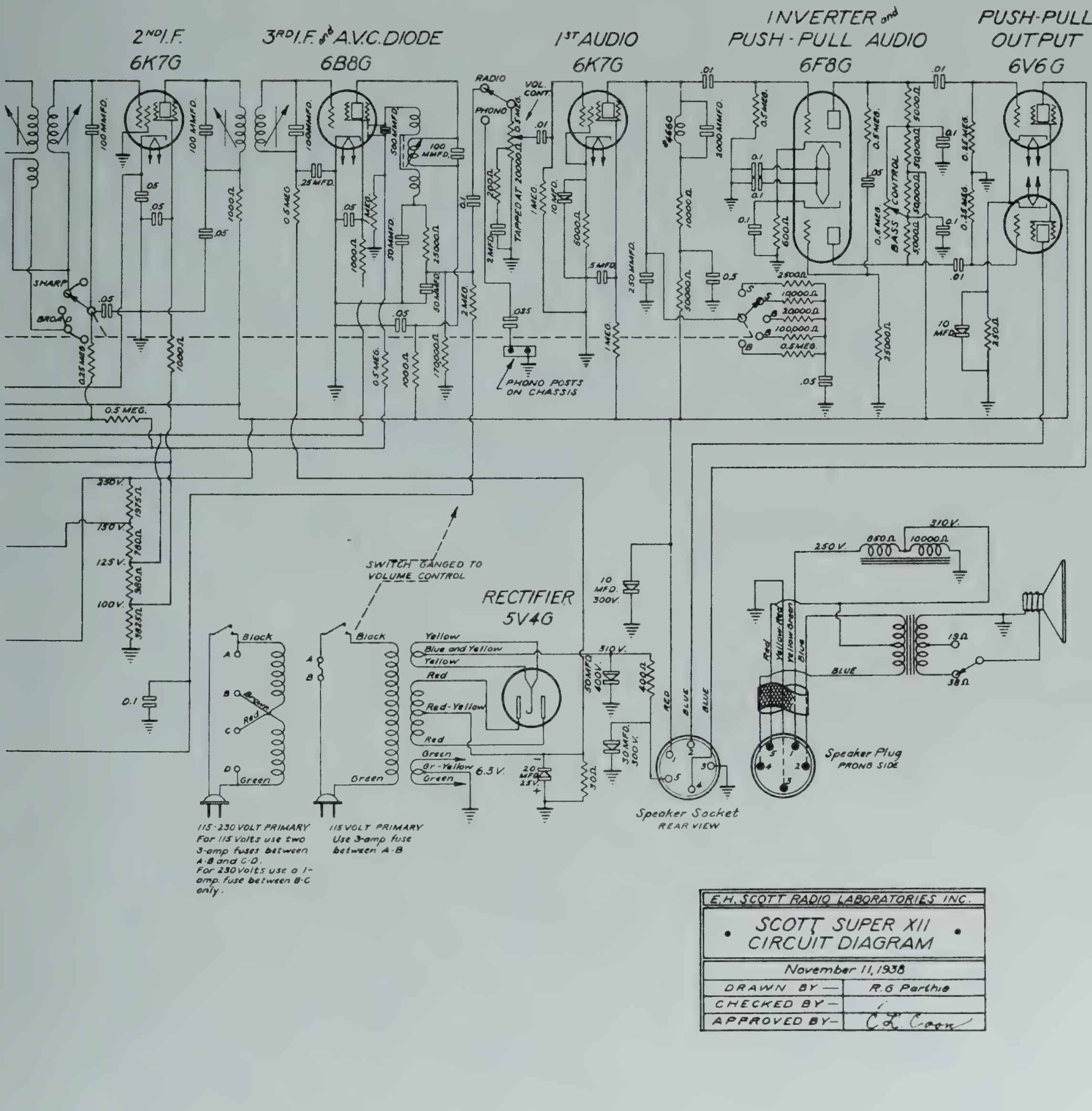
**Scott Sixteen & Eighteen Receiver (Part I)**



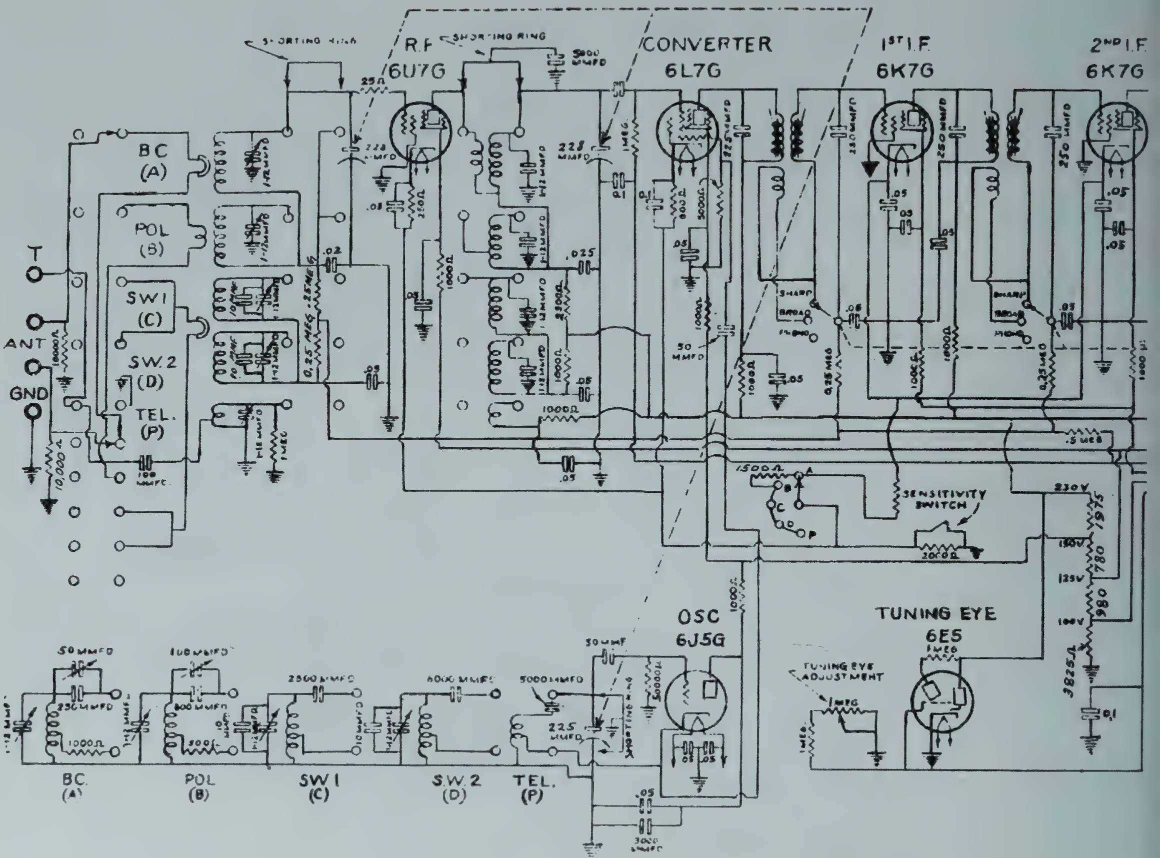
**Scott Sixteen & Eighteen Receiver (Part II-top)**
**Power Supply/Audio Power Amplifier & Speaker Interconnect (bottom)**




**Scott Super XII Receiver (Part I)**




**Scott Super XII Receiver (Part II-top)**
**Power Supply & Speaker Interconnect (bottom)**




SCOTT MASTERPIECE
CIRCUIT DIAGRAM

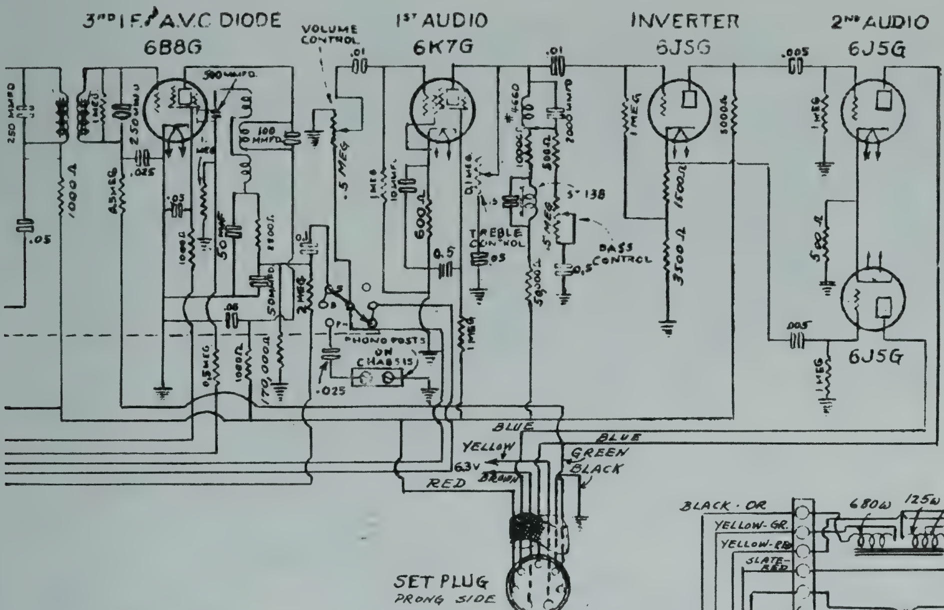
December 11 1939

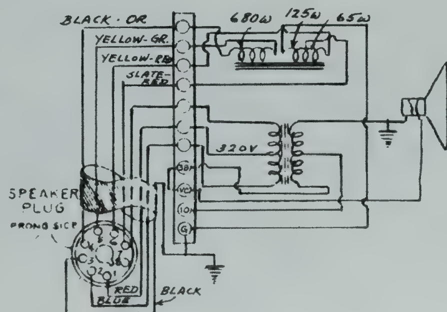
Drawn by Roy Parthie

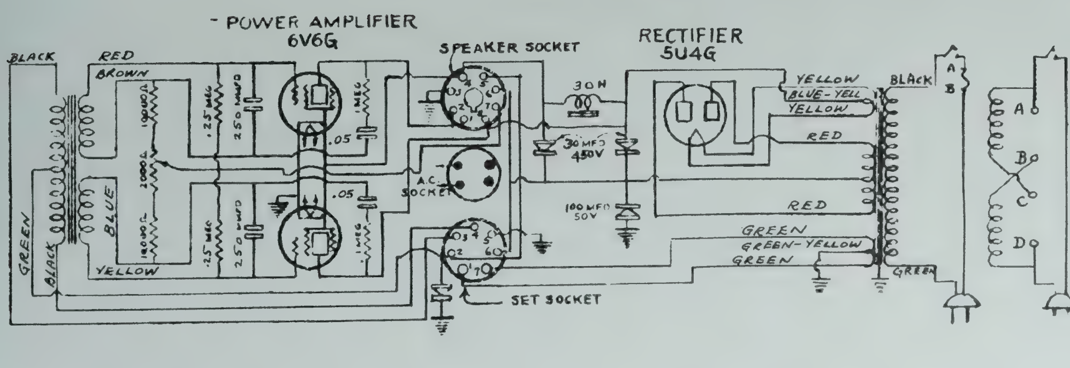
Checked by

Approved by

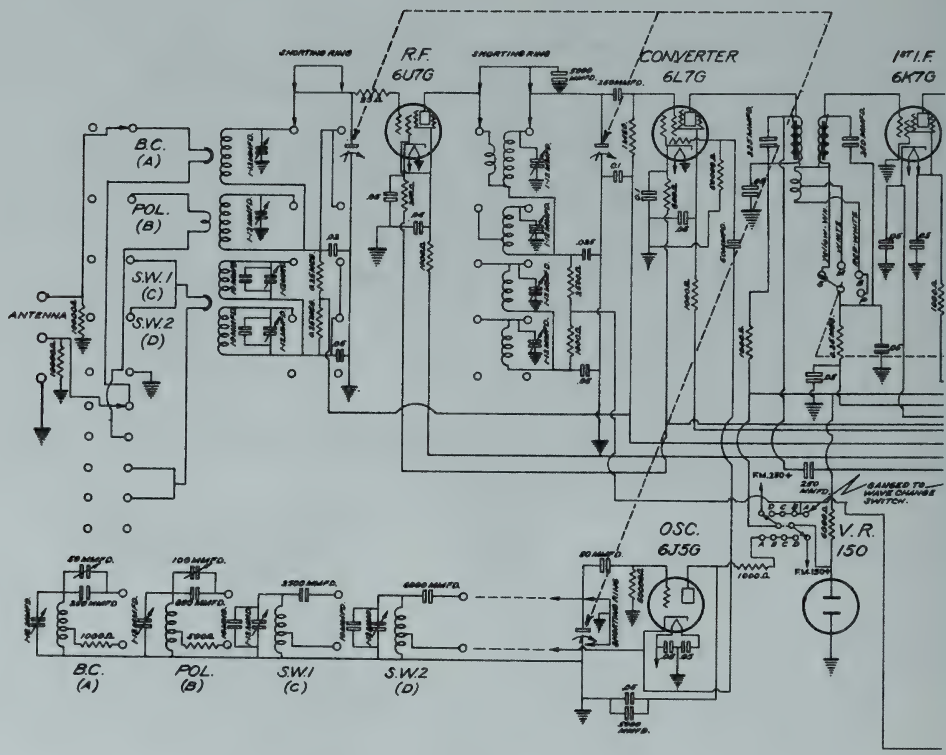
**Scott Masterpiece Receiver (Part I)**



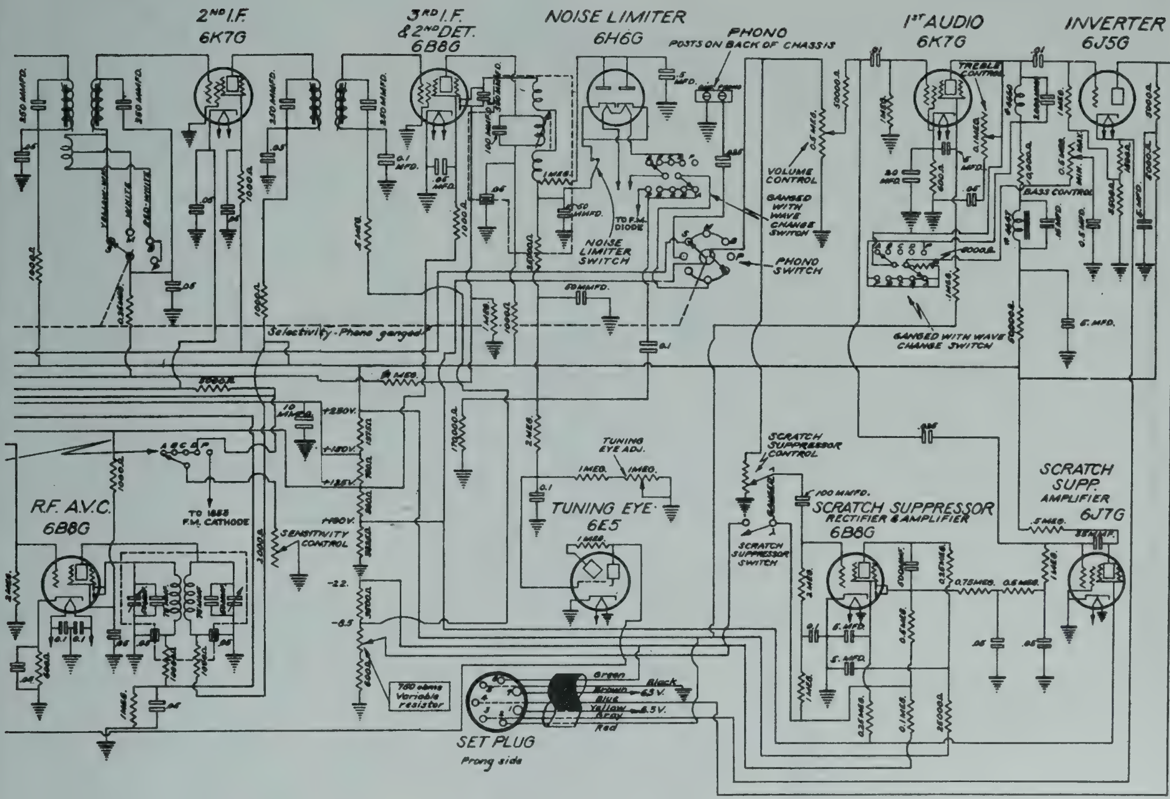




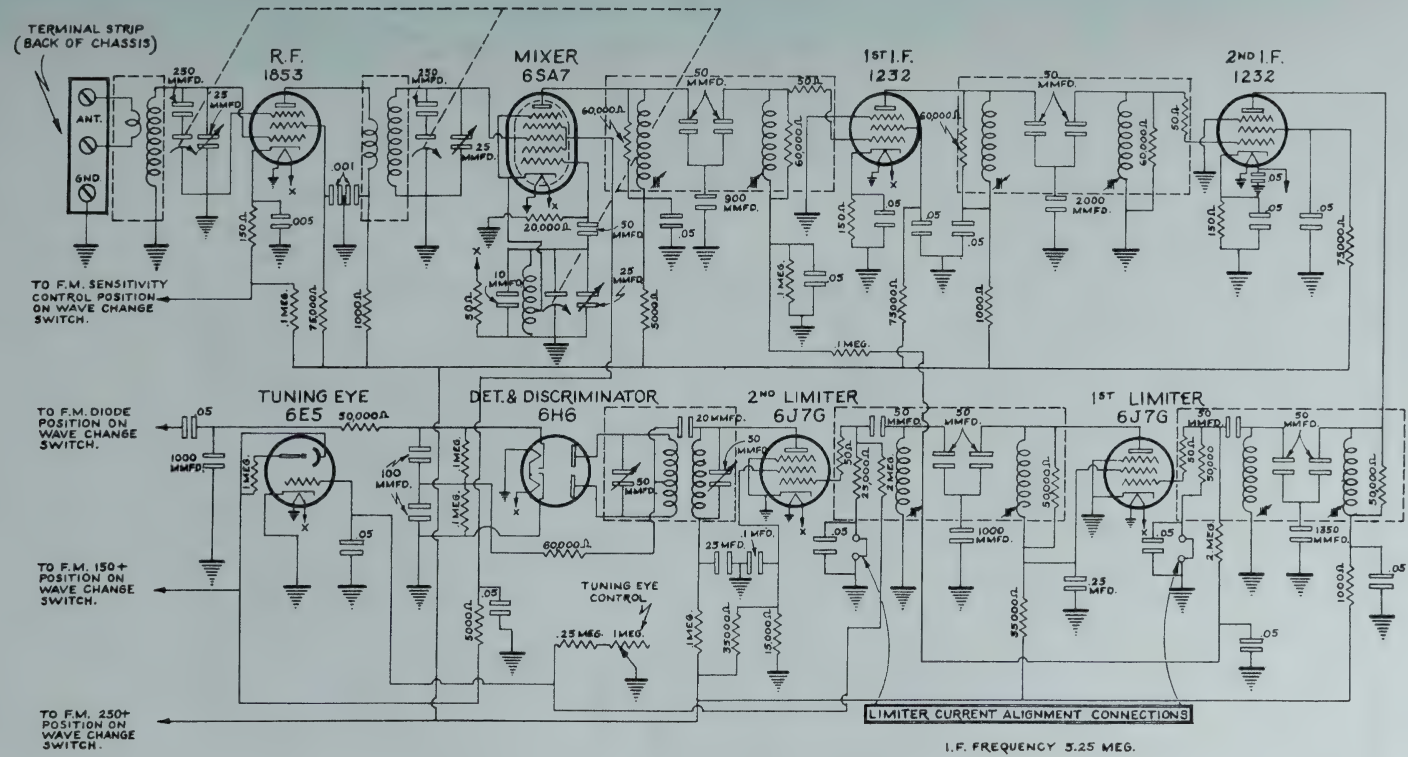

**Scott Masterpiece Receiver (Part II-top)**
**Power Supply/Audio Power Amplifier & Speaker Interconnect (bottom)**



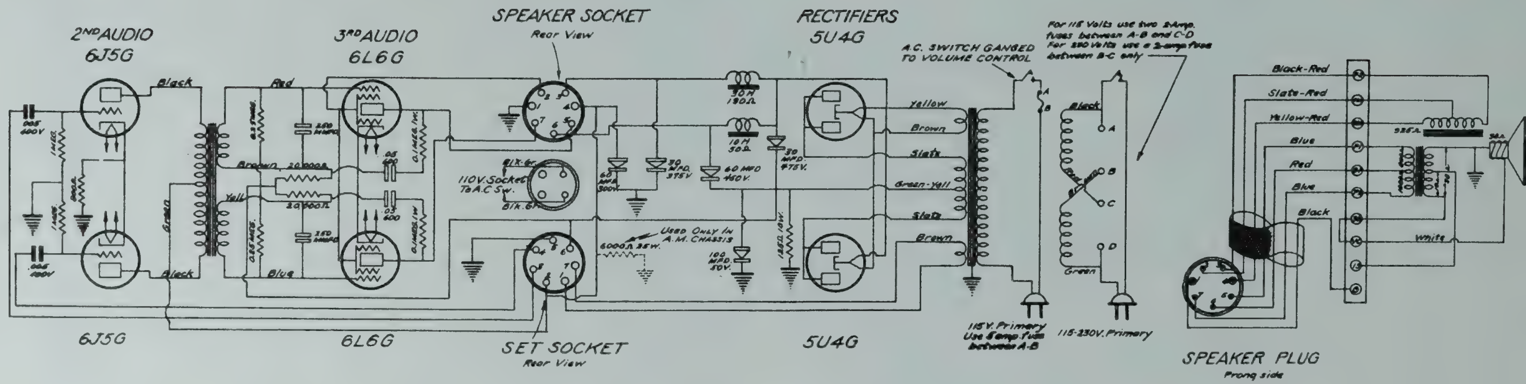

**Scott Phantom Deluxe AM Section (Part I)**



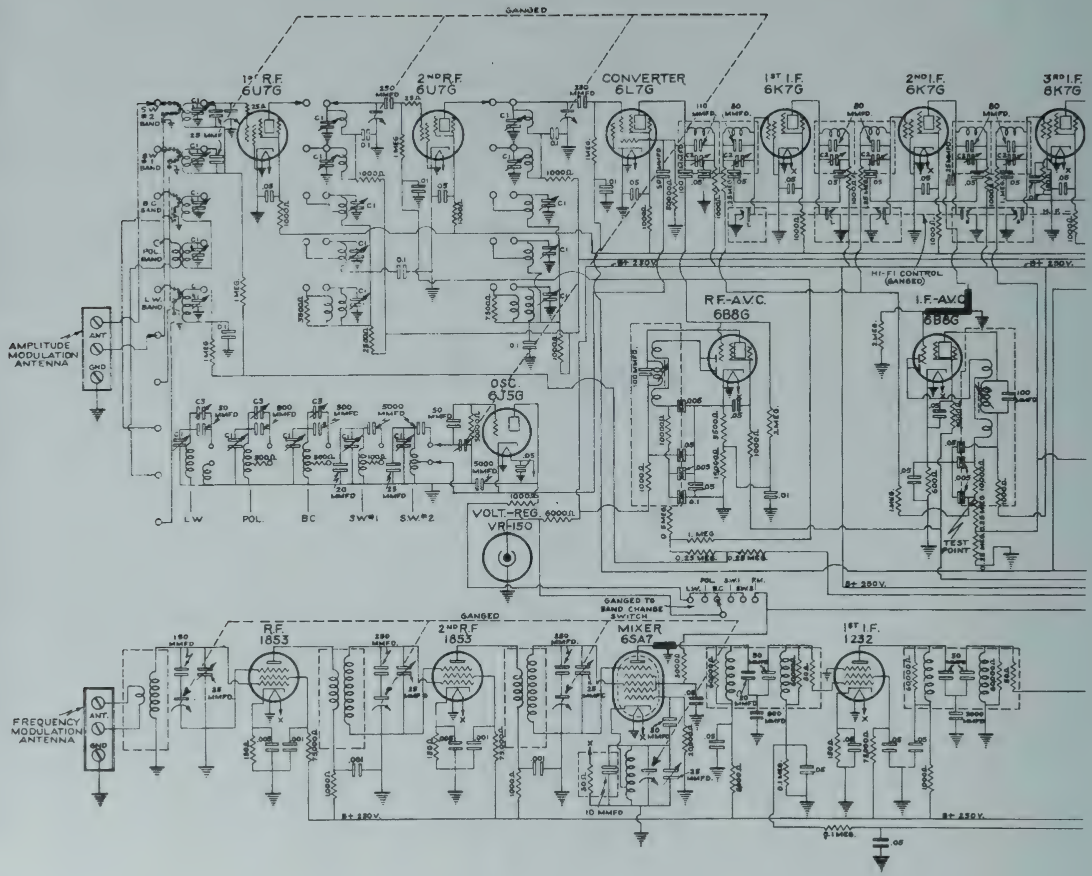

Scott Phantom Deluxe AM Section (Part II)



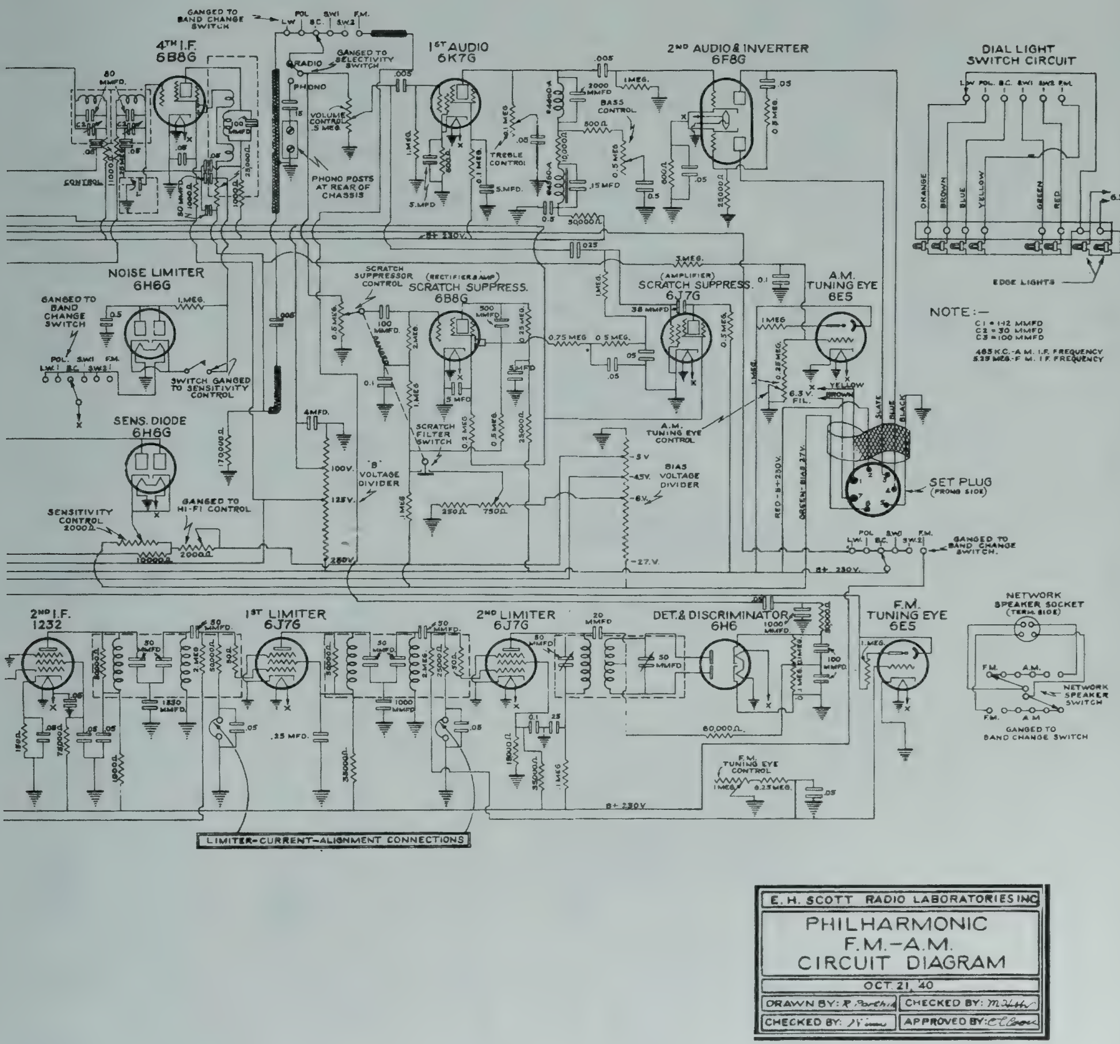

Scott Phantom Deluxe FM Section



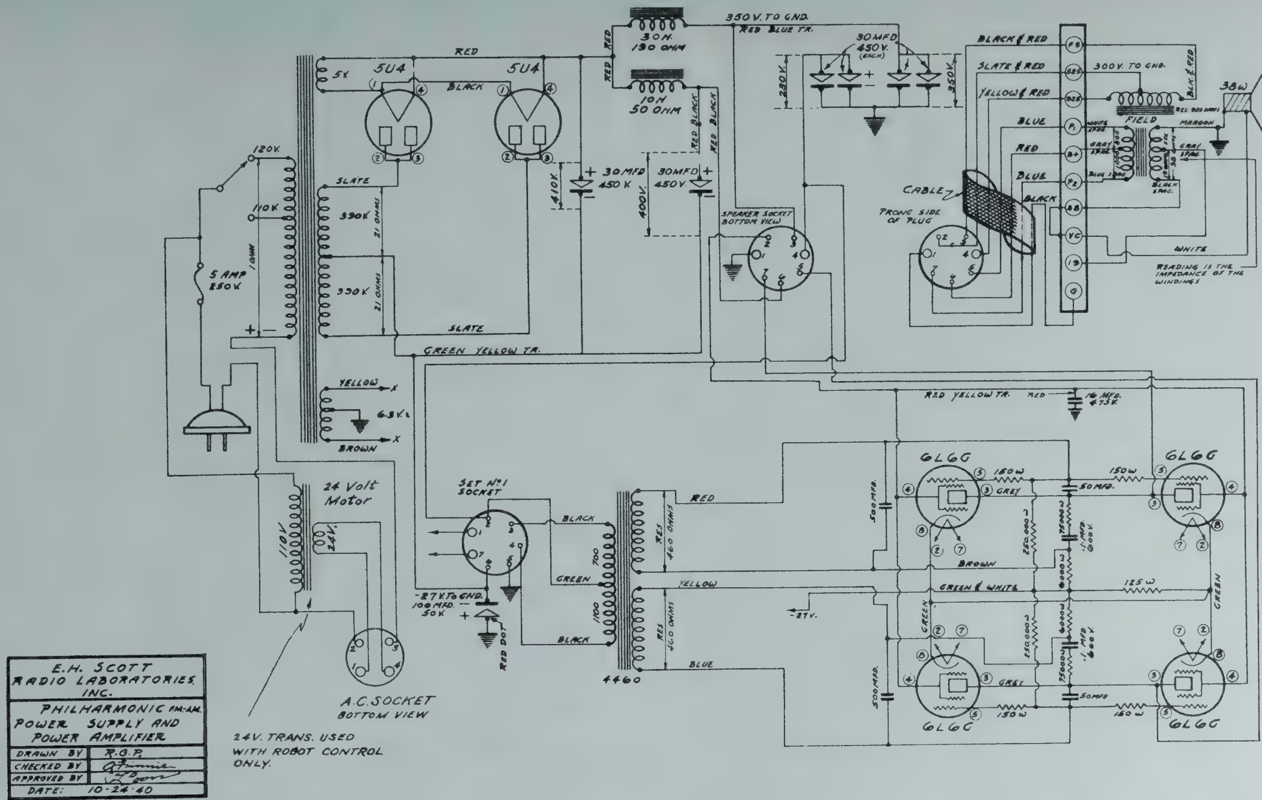

**Scott Phantom Deluxe Power Supply/Audio Power Amplifier & Speaker Interconnection**



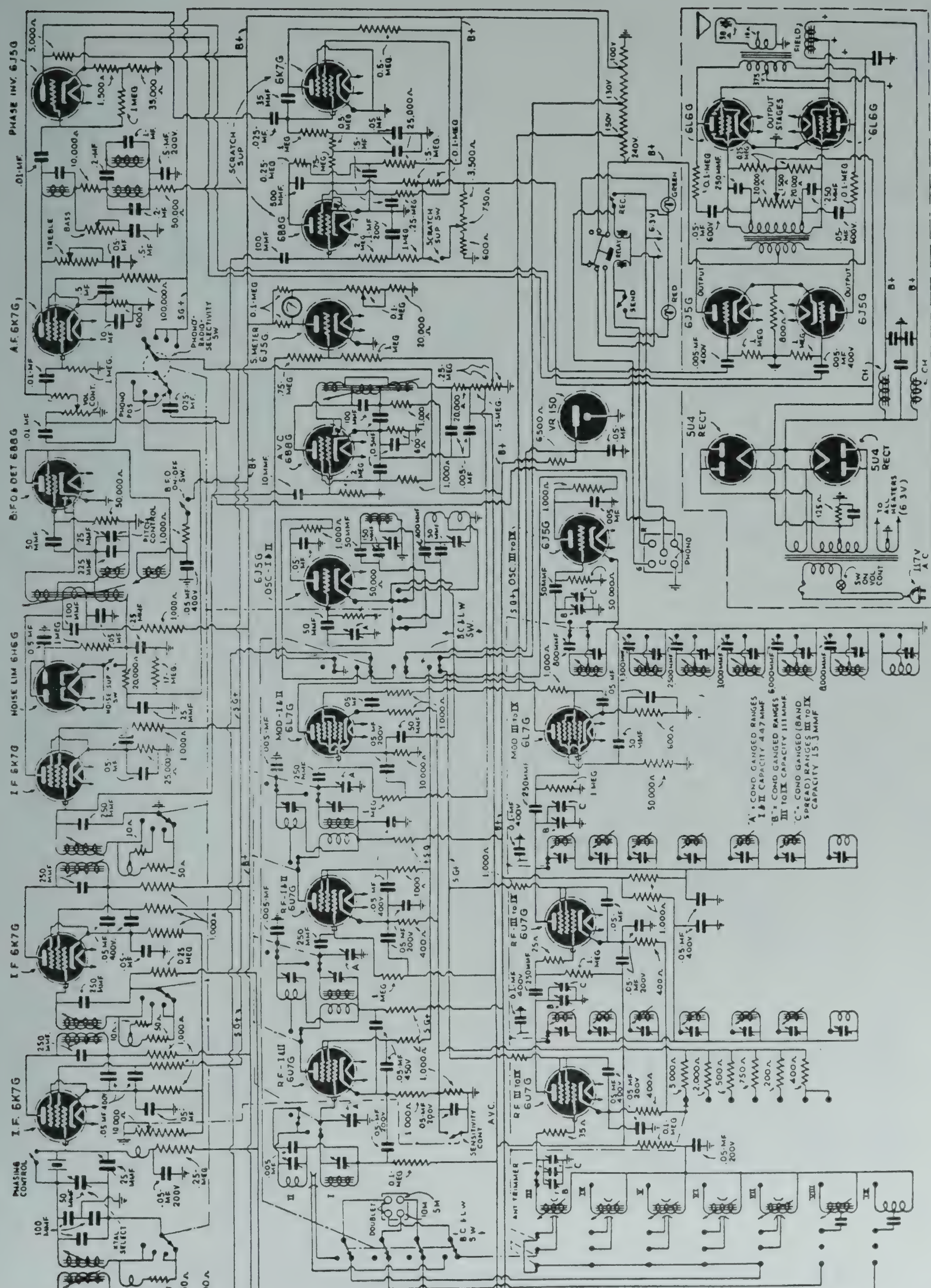

Scott FM Philharmonic Receiver (Part I)



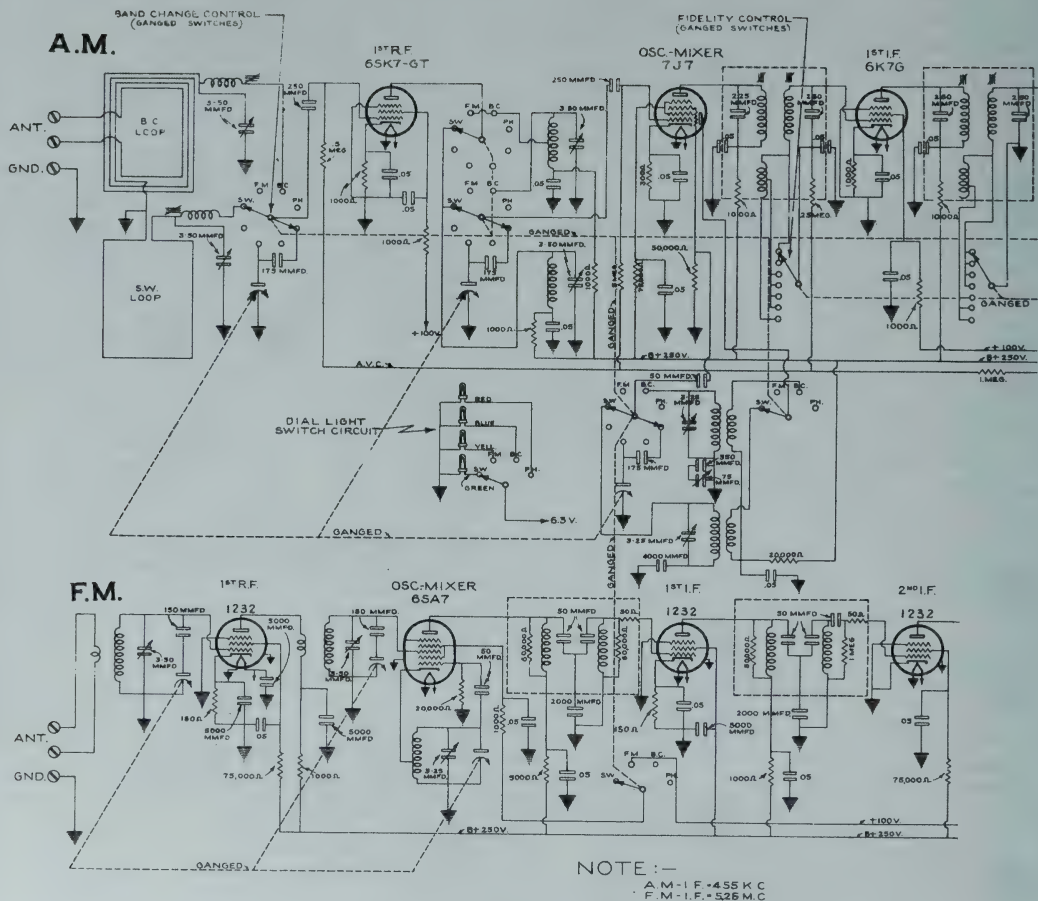

**Scott FM Philharmonic Receiver (Part II)**



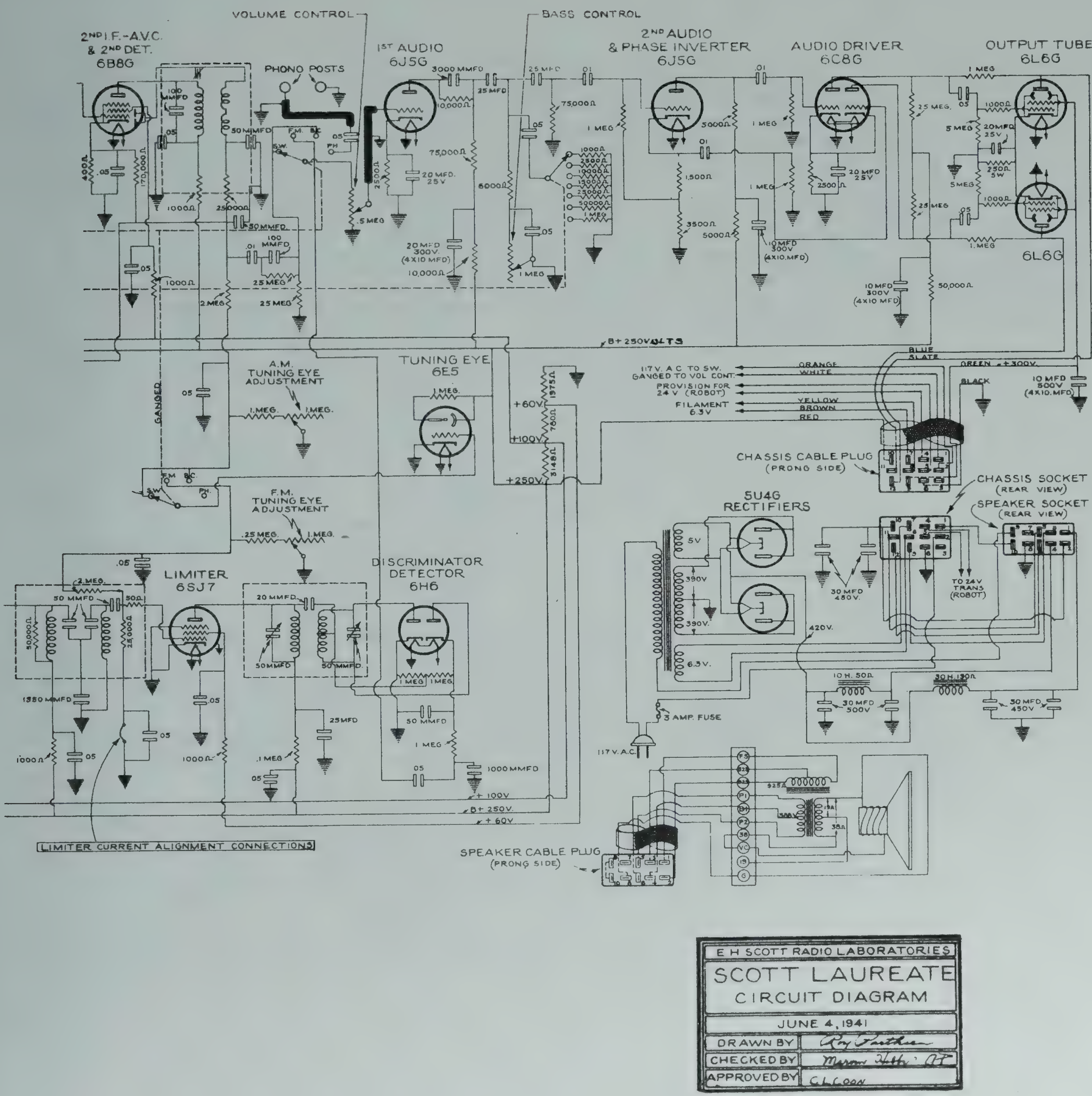

Scott FM Philharmonic Power Supply/Audio Power Amplifier & Speaker Interconnection



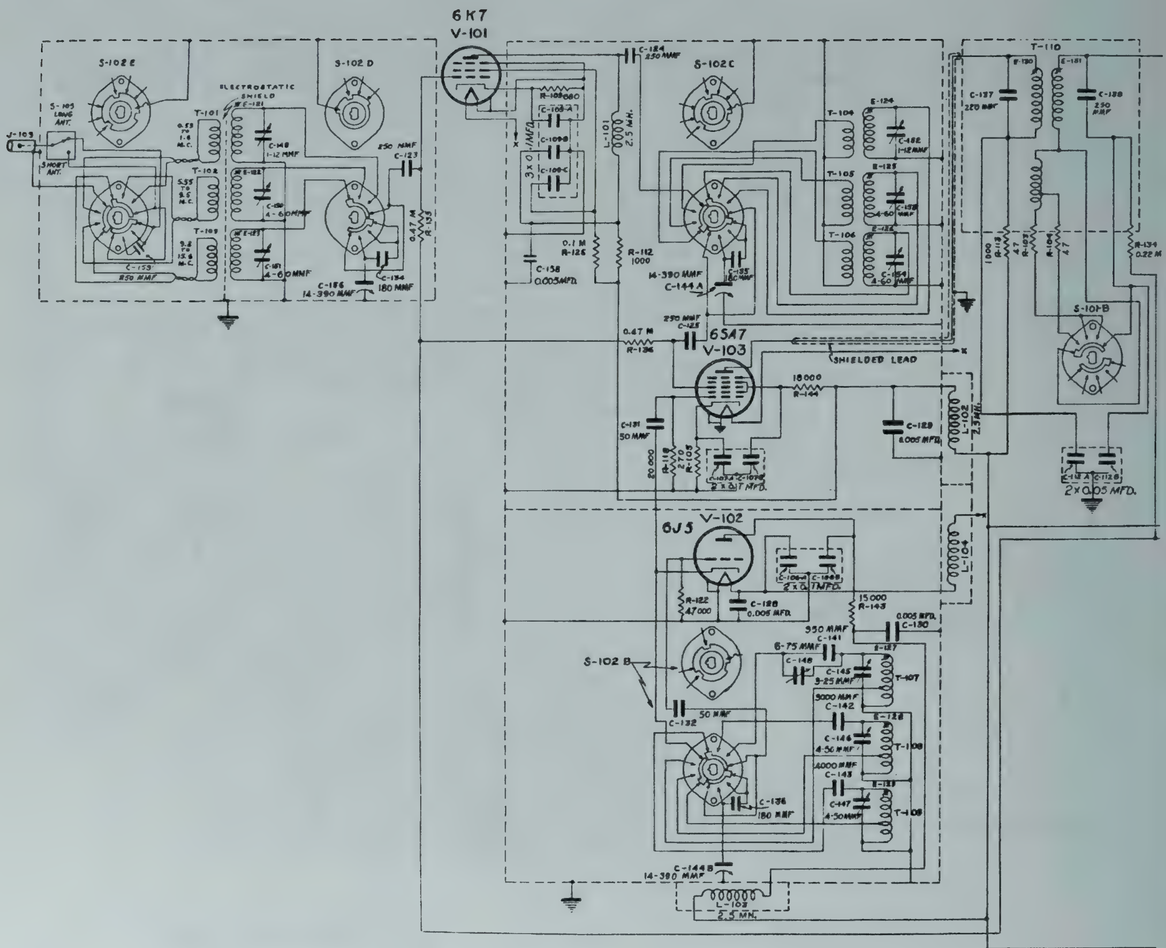
**Scott Special Communications Receiver**



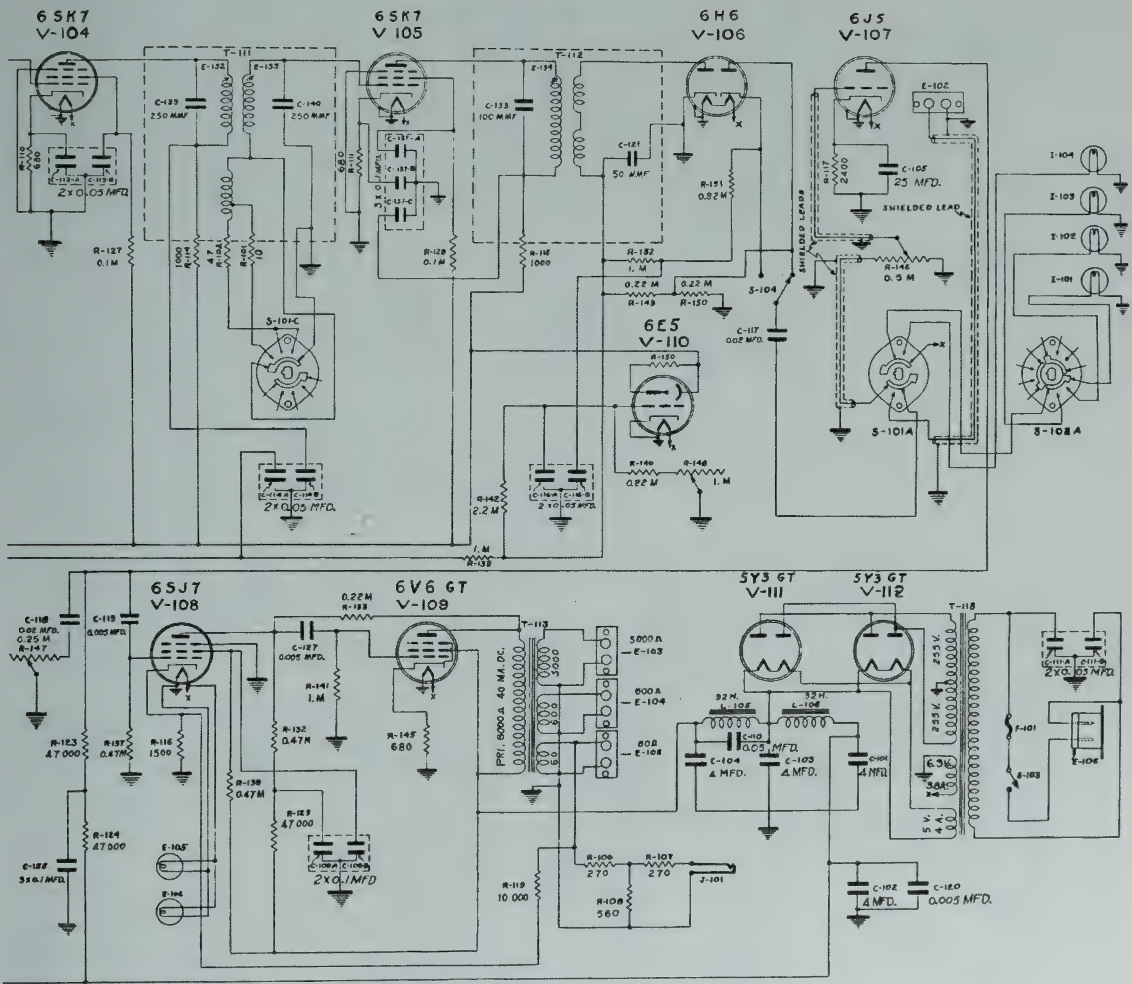

Scott Laureate Receiver (Part I)



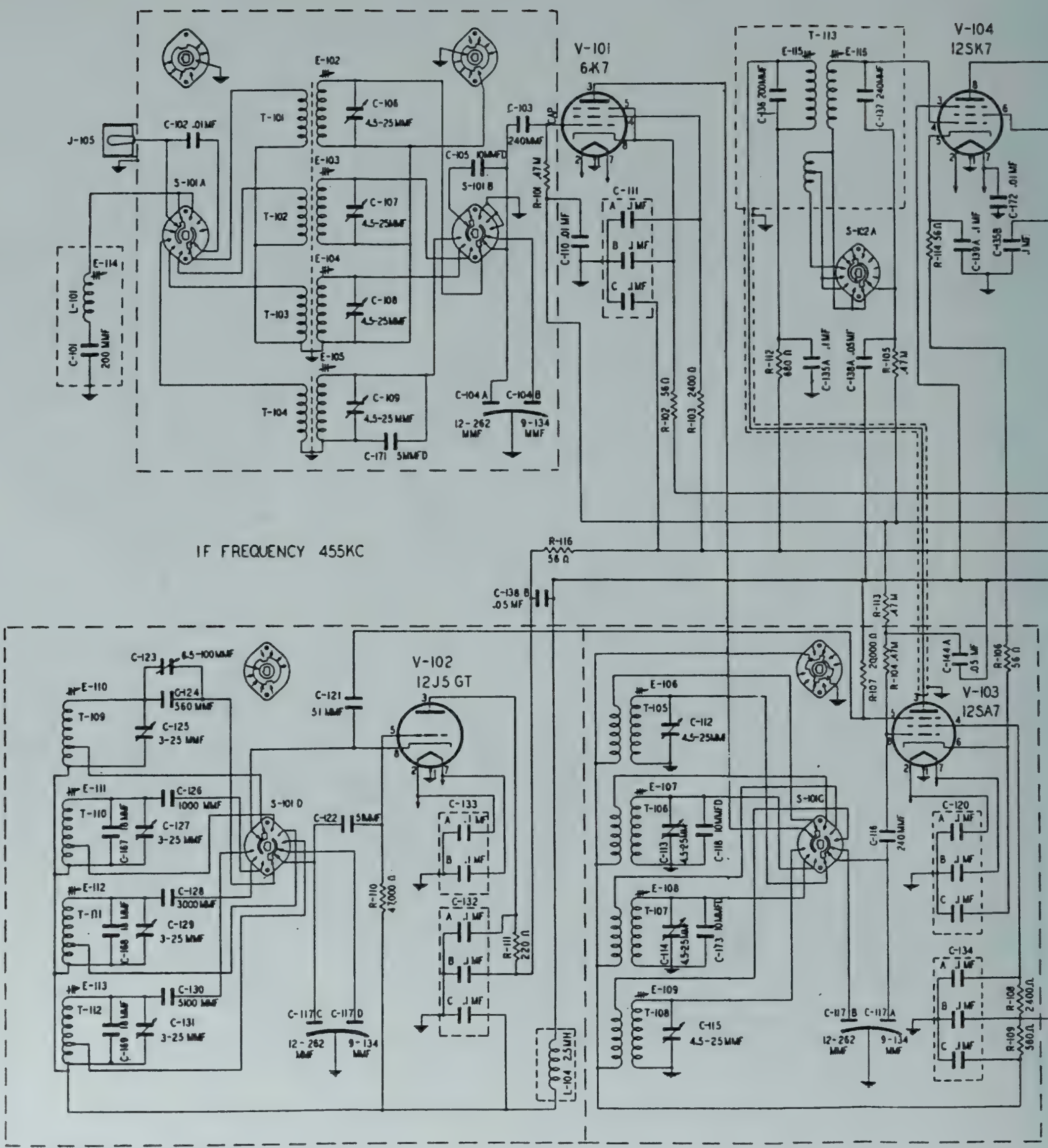

**Scott Laureate Receiver (Part II - top) and Power Supply & Speaker Interconnection (lower right)**



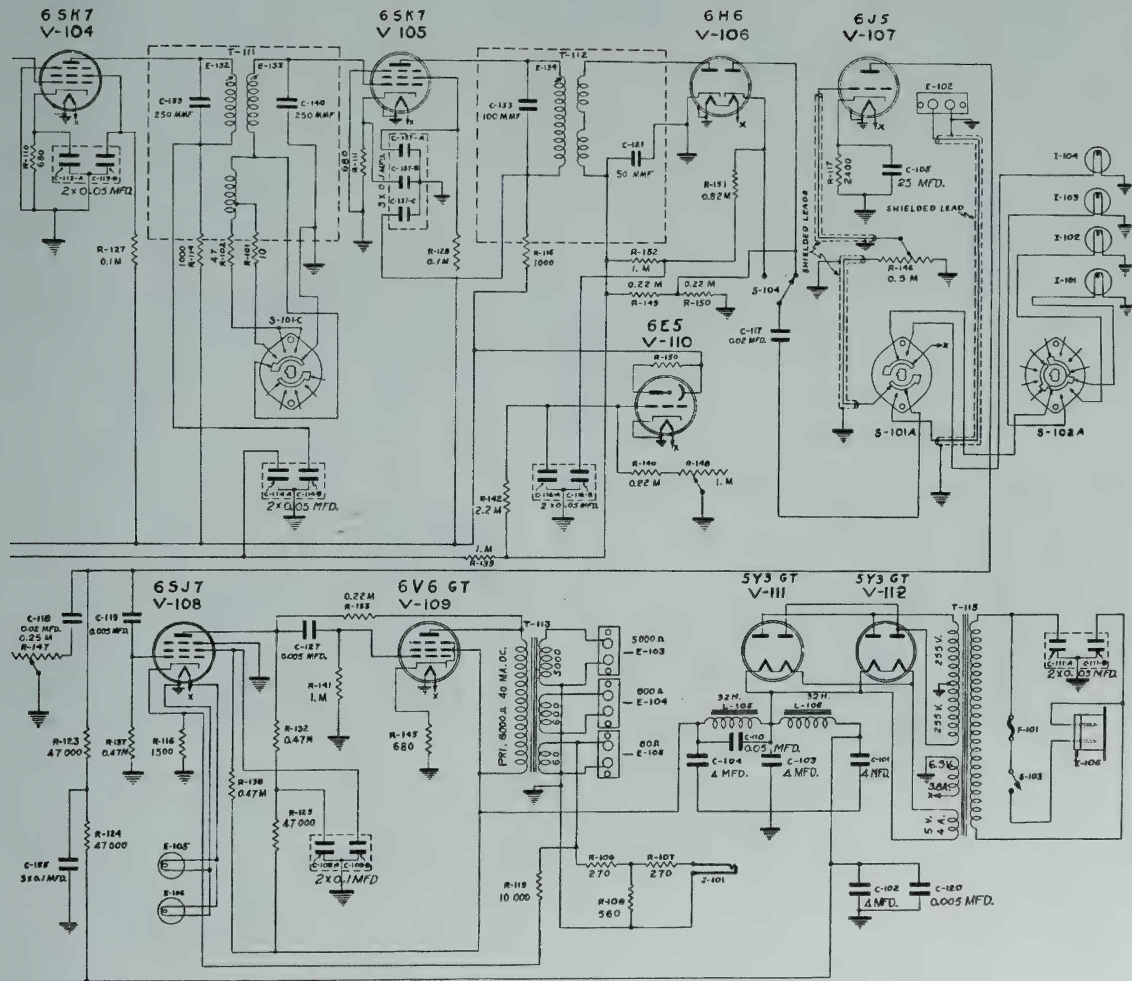
**Scott RBO Series Morale Receiver (Part I)**



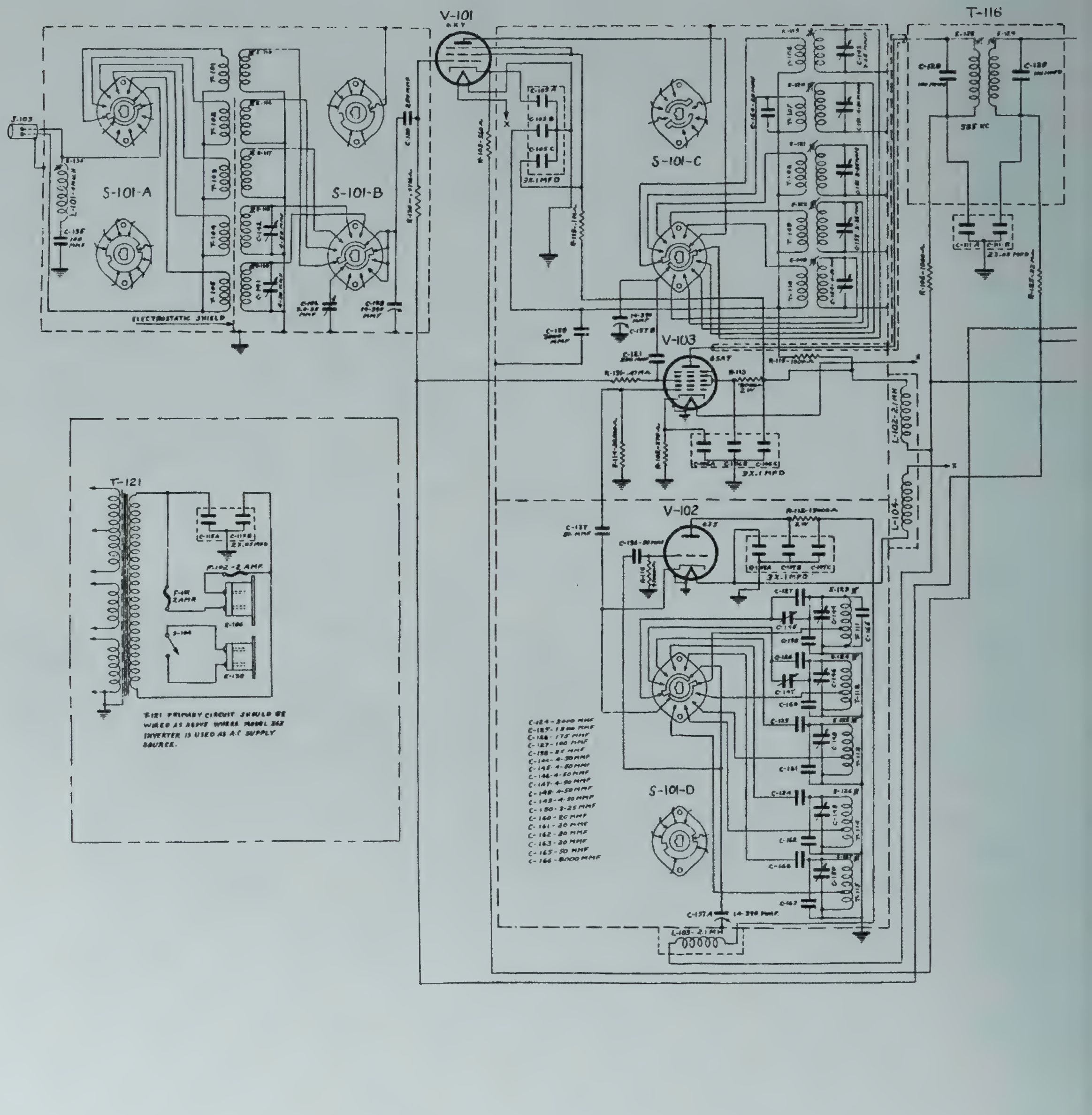

**Scott RBO Series Morale Receiver (Part II)**



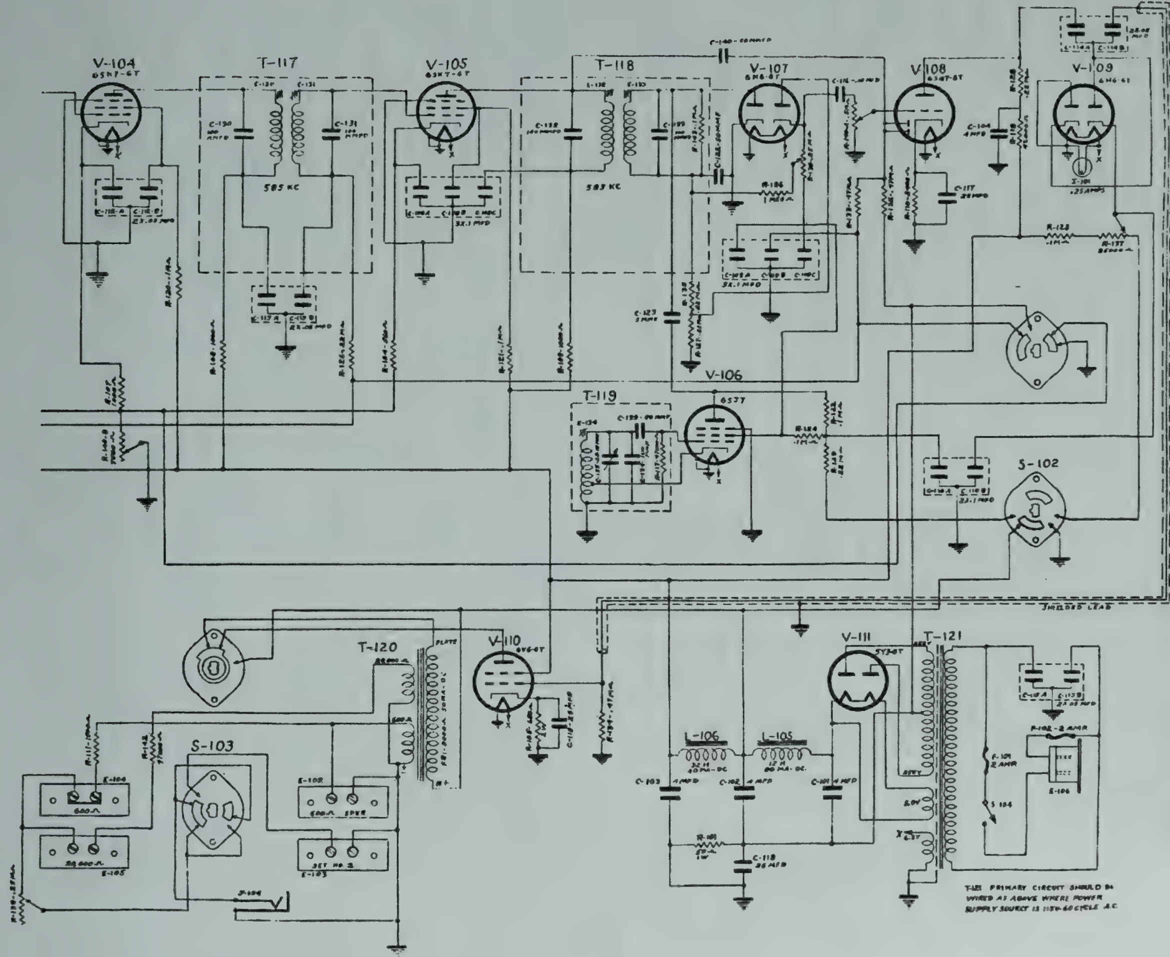

**Scott SLR-M/REE Series Morale Receiver (Part I)**



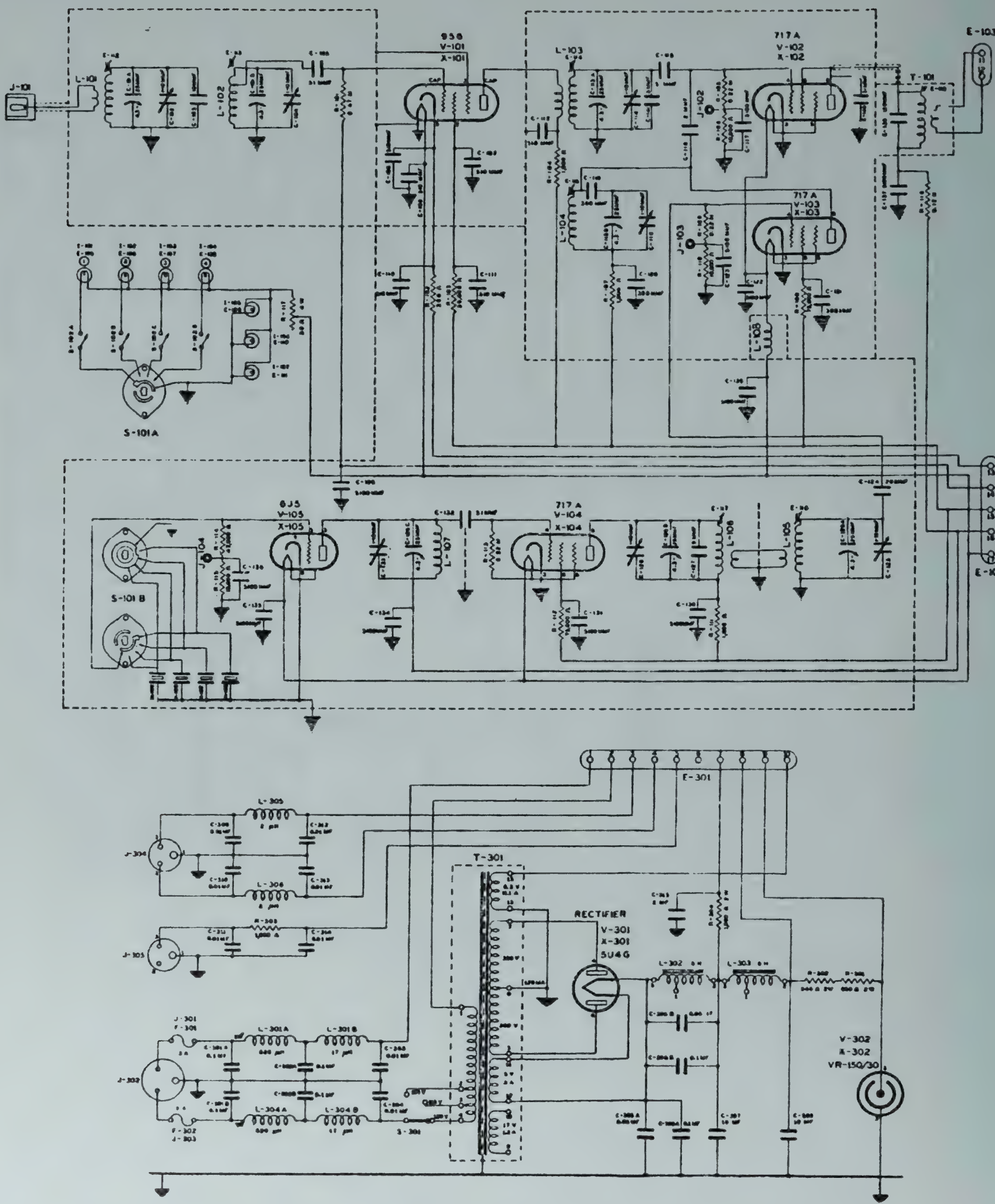

Scott SLR-M/REE Series Morale Receiver (Part II)



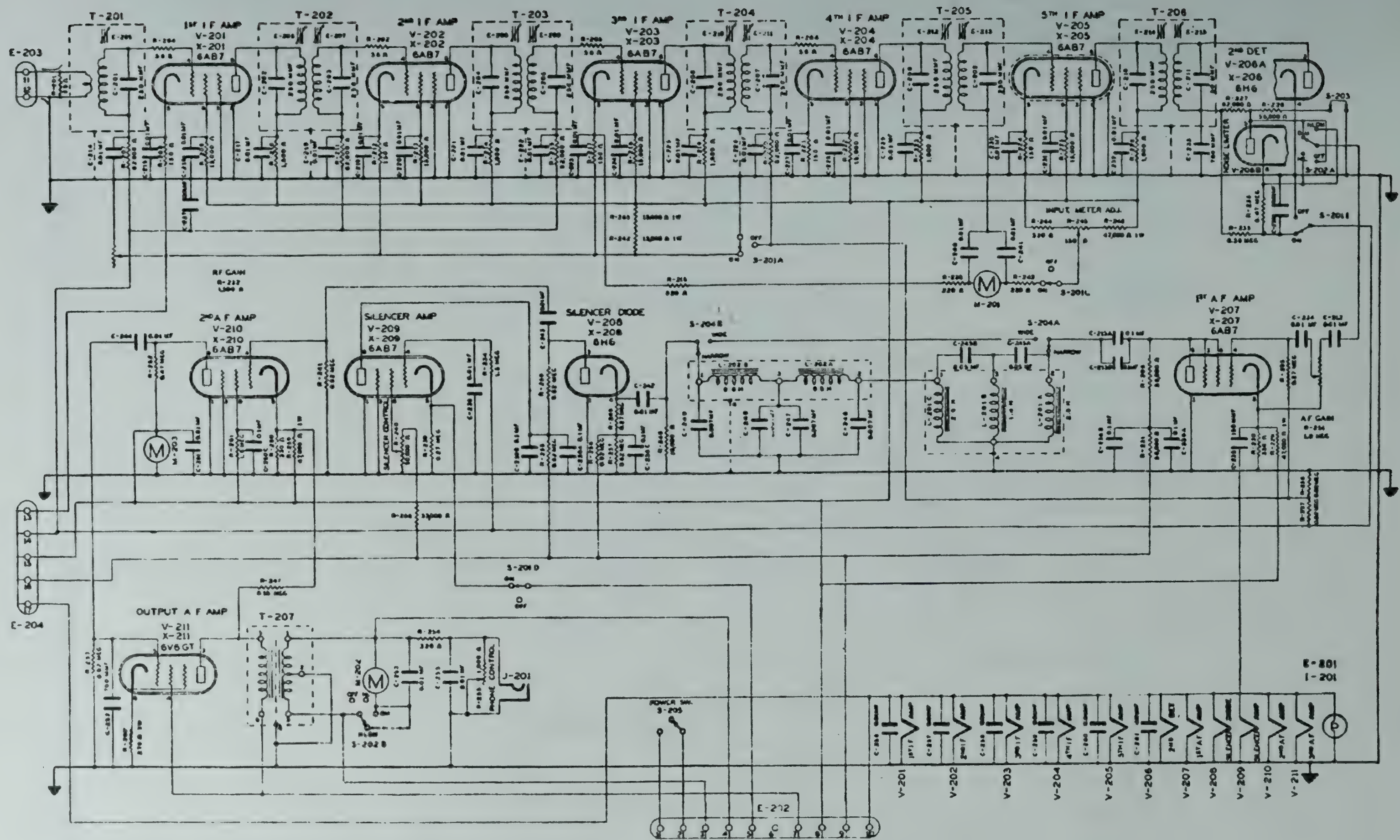

**Scott RCH Series Morale Receiver (Part I)**



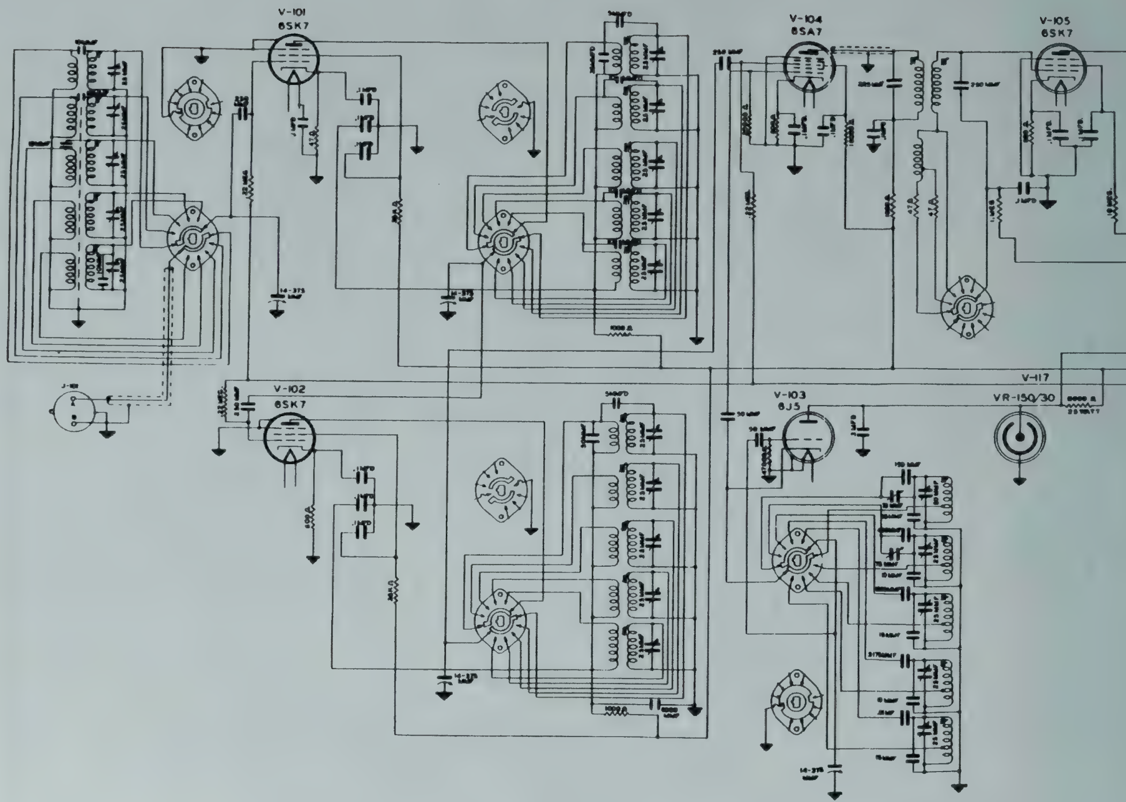

Scott RCH Series Morale Receiver (Part II)



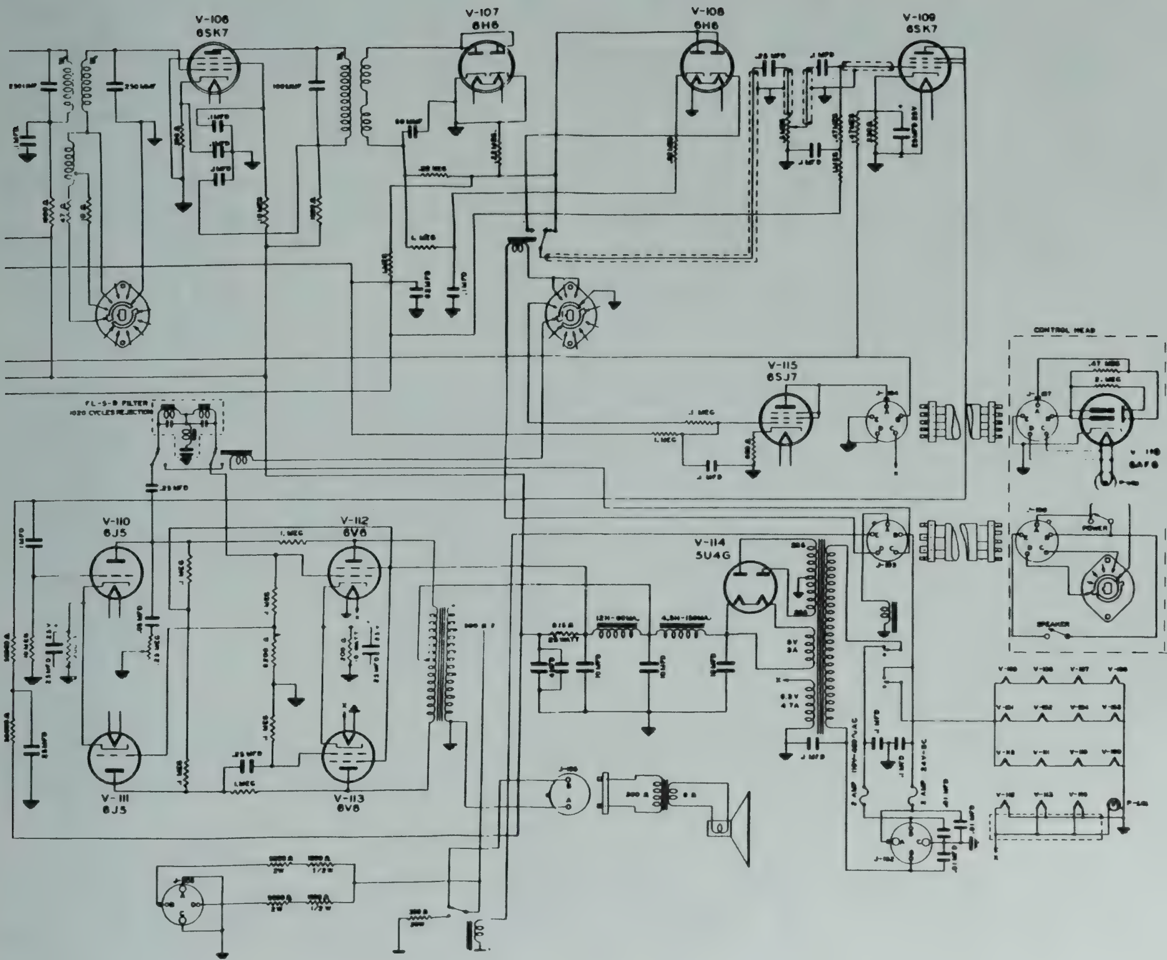

**Scott RCK Series Morale Receiver (Part I) - Front End (Top)
Power Supply (Bottom)**



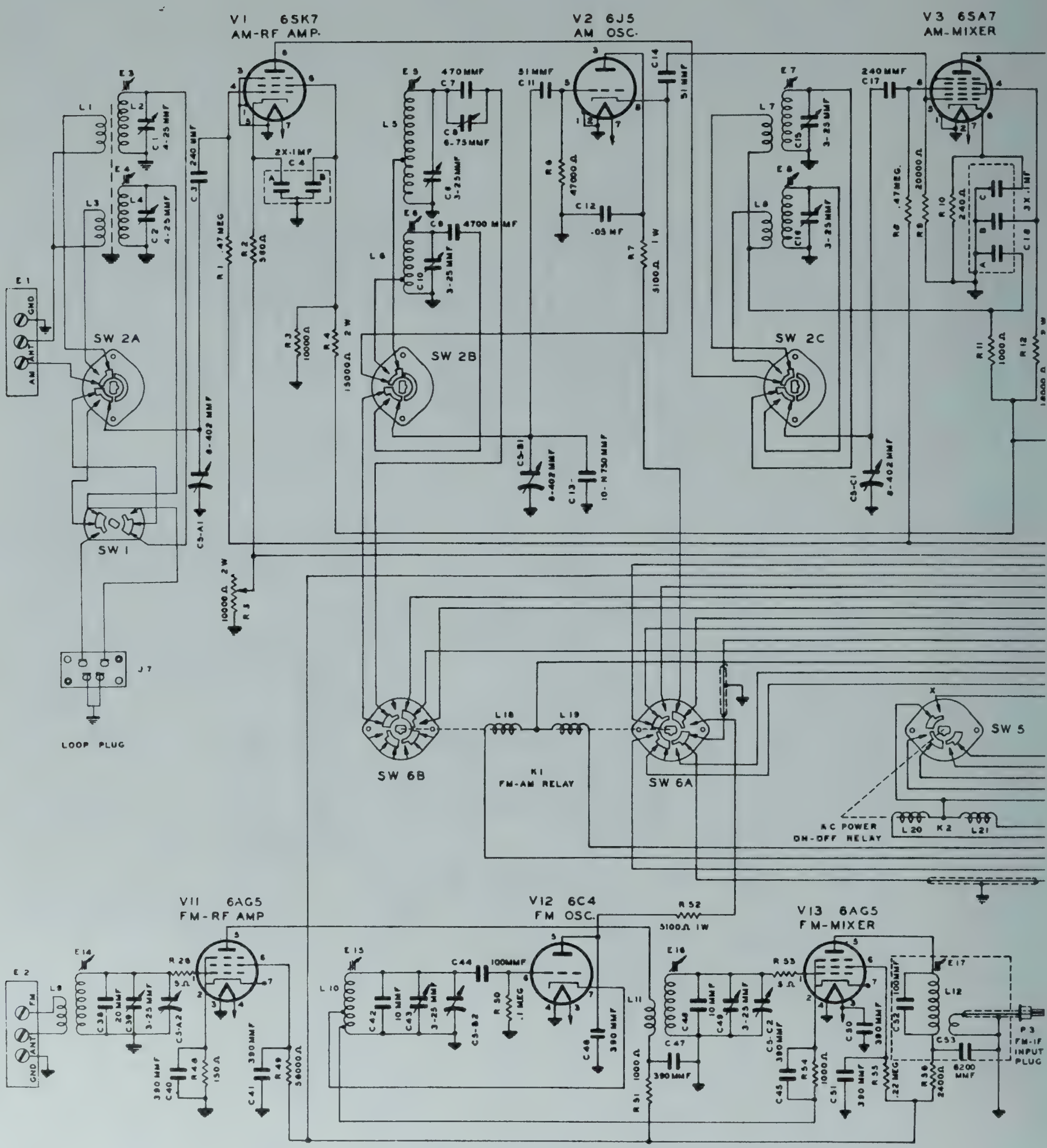

Scott RCK Series Morale Receiver (Part II) - Back End



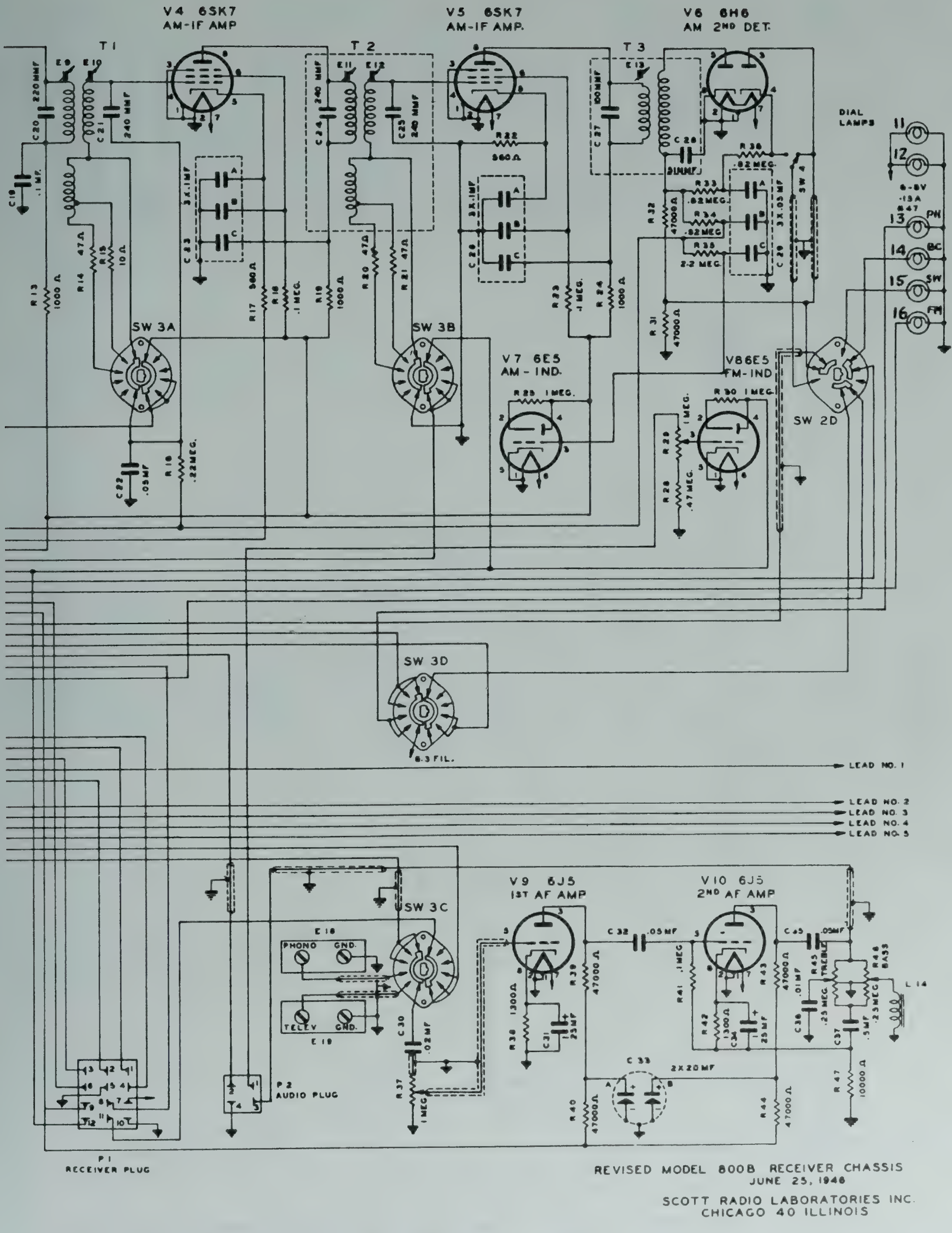

**Scott Model AR-1 Presidential Aircraft Radio Receiver (Part I)**



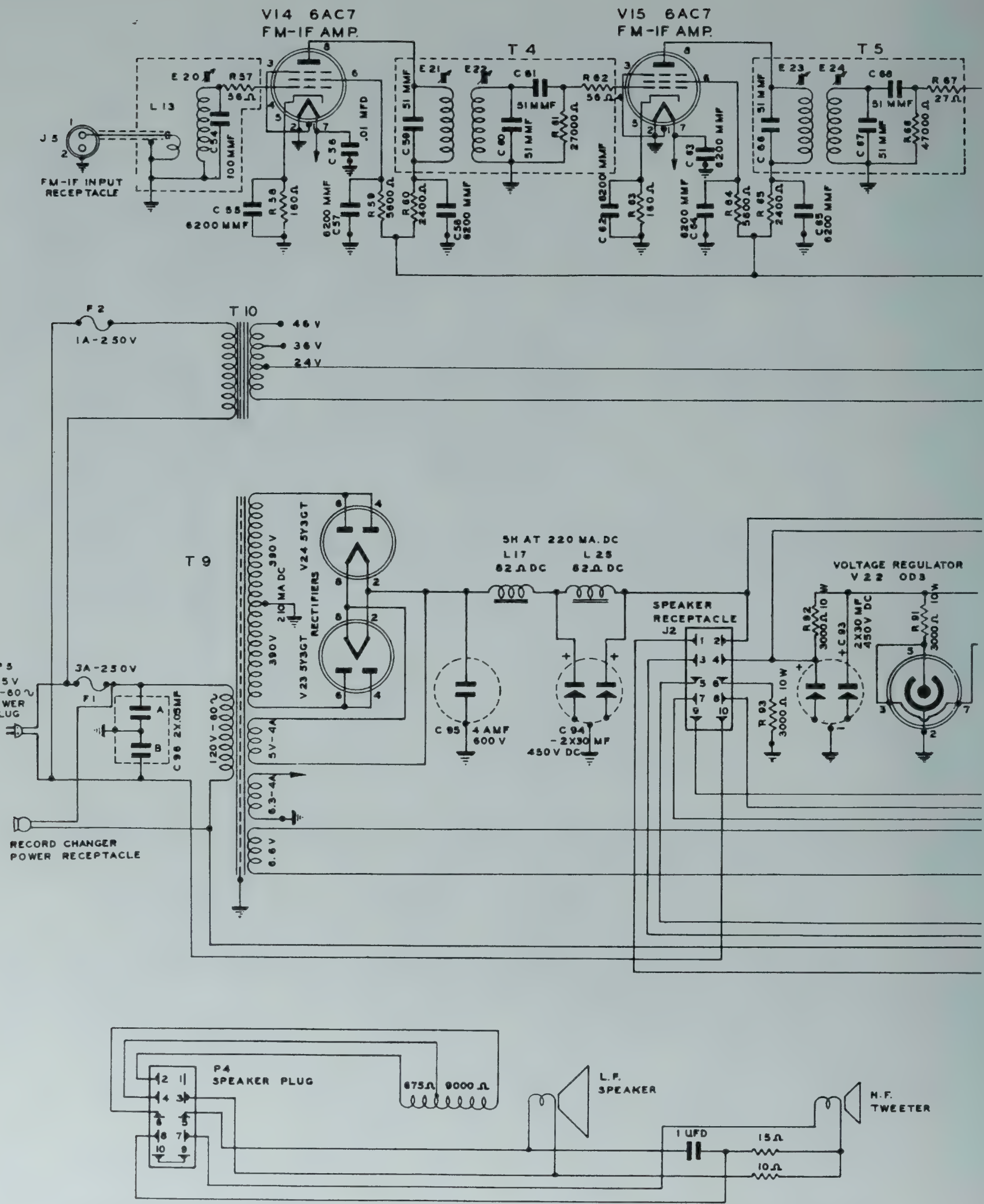

**Scott Model AR-1 Presidential Aircraft Radio Receiver (Part II)**



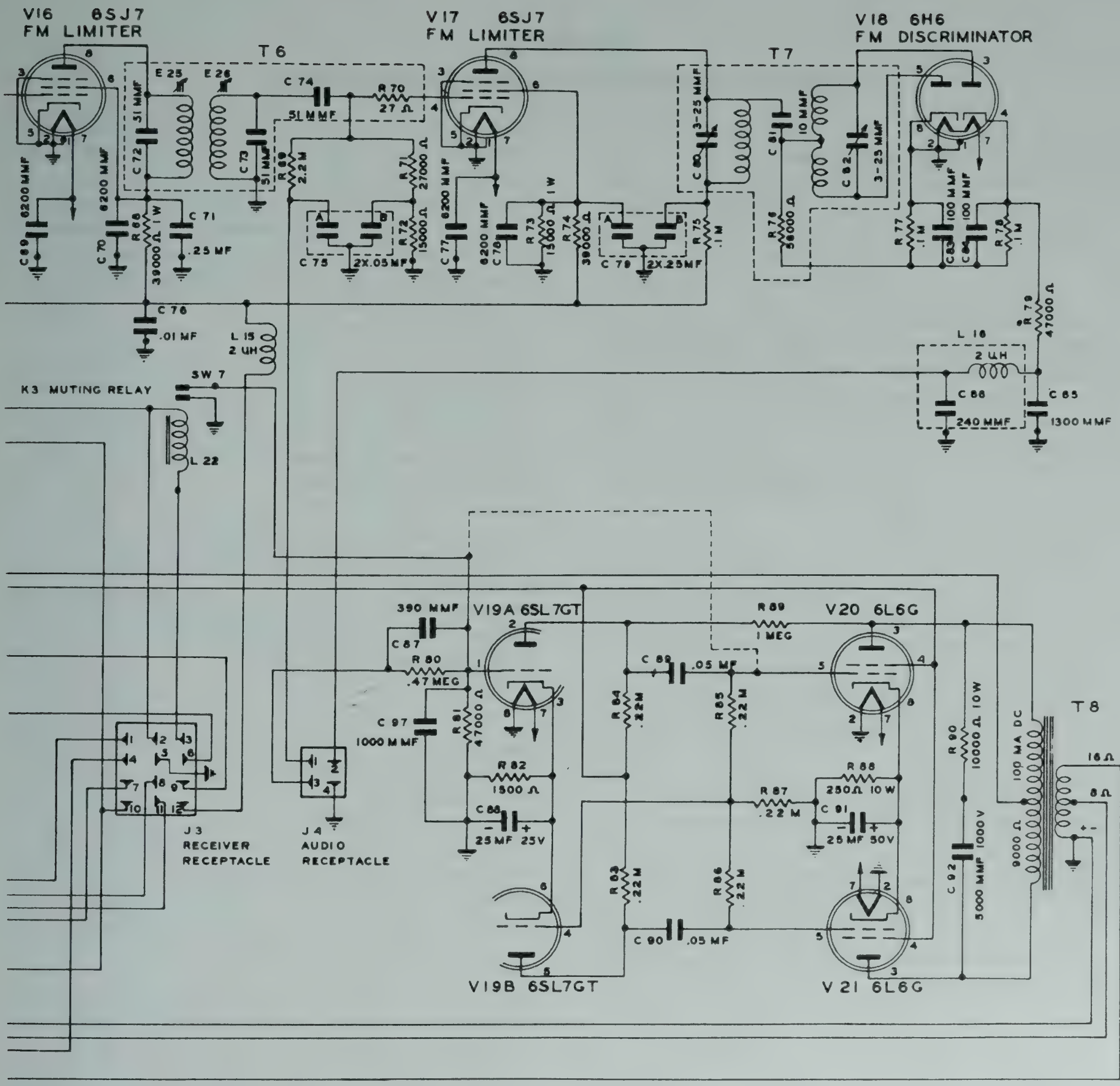

Scott Model 800B Receiver (Part I)




**Scott Model 800B Receiver (Part II)**



Scott Model 800B FM Section, Power Supply/Audio Power Amplifier and Speaker Interconnection (Part I)




REVISED MODEL 800 B POWER SUPPLY
JUNE 25, 1946

SCOTT RADIO LABORATORIES INC.
CHICAGO 40 ILLINOIS

**Scott Model 800B FM Section, Power Supply/Audio Power Amplifier (Part II)**

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**The "Sacred Cow" - The First Presidential Aircraft Utilized A Custom Scott Radio For President Roosevelt Designed By Marvin Hobbs**

During the Golden Age of Radio, the vision of one man, E.H. Scott, continually set the highest standards for radio receiver technical performance, innovation and quality. The products of his company, E.H. Scott Radio Laboratories, were considered status symbols of their day - most with chrome plated chassis, high fidelity sound reproduction and elegant cabinets. Today, those Scott radios are some of the most highly treasured by vintage radio collectors.

Here is the story of Scott and his Company as related by Marvin Hobbs, Scott's Chief Engineer from 1939-1947. Hobbs' key role with Scott, his first-person recollections, and extensive industry experience offer a most unique and interesting insight into a fascinating piece of the history of radio.

## About The Author

Marvin Hobbs, a B.S.E.E. and Ph.D. in Engineering Management, has retired from a long and distinguished career in the radio and electronics industry. Prior to joining Scott Radio Labs, he was a receiver design engineer for Zenith Radio, the Delco Radio Division of General Motors and E.K. Cole, Ltd. in England. In 1939, he became the Chief Engineer of Scott Radio Laboratories in Chicago, Illinois. Marvin served with the Radio and Radar Division of the War Production Board during World War II in 1942 and part of 1943. Afterward, he returned to Scott Radio until 1947. In 1947, he joined RCA and worked on its Berkshire program, followed by a role in 1950-1952 as Chief, Electronics Division, Munitions Board, the Pentagon. From 1952 until his retirement from Bell Telephone Laboratories in 1982, he held various technical and management positions in industry. Mr. Hobbs has done consulting on telecommunications and has written ten books on radio and electronics.

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A Division Of Radio Daze, LLC
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ISBN 0-9723301-0-0
52995
9 780972 330107